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Original Articles

DENTOFACIAL MUSCULATURE

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NO COMPREHENSIVE study of the elements that contribute to the development and maintenance of normal dental structures can confine itself to but one phase of the subject. Among the more important factors that influence this ideal, however, there is ample evidence of the prominent role played by those known as the muscular. It is intended that this study shall be limited to an examination of those muscles or groups of muscles that are influential in establishing what is termed normal occlusion of the teeth, with due consideration of the principles of balance, symmetry, and stability throughout the entire dentofacial area.

Muscular influence on teeth is possible because of several factors. Teeth generally tend to move in the line of least resistance until a balance is struck between the various forces that affect them. This is the manner in which they assume their final positions. Herein enters the factor of muscular action, for the development of the denture depends for the most part on teeth being maintained in position by an equilibrium of the muscular forces that play on them. Inherent growth factors, and others, are also important but since none of them are fully pertinent to a limited study of musculature, they are mentioned briefly only to give recognition to the influence they have in assisting the achievement of stability in the denture.

The teeth are placed in a bony foundation that when vital is not brittle and unyielding, but plastic and pliable and easily modified when subjected to pressure or stress. Given normal muscular stimulation, the teeth thereby achieve a state of pleasing balance and symmetry, after which movement ceases (Fig. 1). However, the activating forces are always present. Continuing normally, they will maintain this ideal condition. But with any deviation or perversion, they will throw the entire denture out of symmetry to establish a new balance that, of course, will be in the nature of a deformity. Ultimately the effect is trans-

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mitted to the relatively remote facial bones, creating major or minor deformities depending on the extent of the muscular perversion.

There is a difference in the muscular requirements of these facial bones. The maxillae have a direct bony attachment to the cranium with the result that their forward growth program is materially assisted by the forward growth of the cranial bones. The mandible receives none of this help, since its principle connection with the rest of the head is through the temporomandibular joint and the articulation of the teeth. Therefore in order to keep up with the forward growth of the maxillary structures, it needs masticatory function and stimulation through cuspal interdigitation in order to achieve its complete development.

The involved muscular system known as the tongue may be considered as a form or mold around which the teeth are grouped in the shape of an arch. The intricate musculature of the lips and cheeks confines the teeth to this form from without. The muscles of mastication contribute function. The teeth, through their cusps, contacts, inclined planes, and inclinations meet each other in a definite preconceived plan, with the forces of mastication, deglutition, speech, and respiration assisting in development. With the slightest perversion of any of these forces, the entire denture sacrifices symmetry to produce a deformity in exact ratio to the degree of abnormality presented.

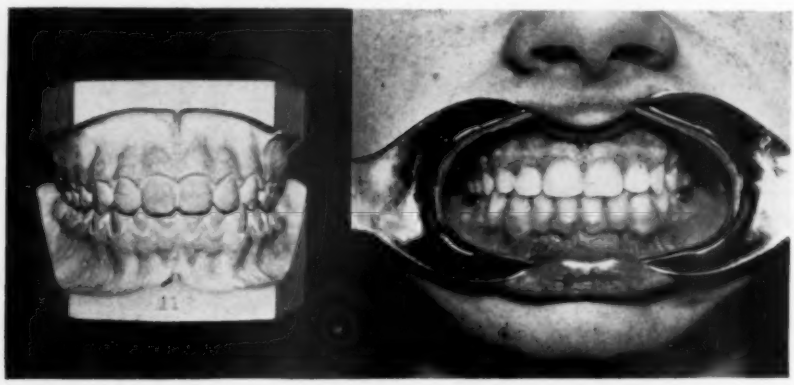

Fig. 1.—Photographs to show pleasing balance and symmetry of the teeth, which are necessary if normal facial structures and contours are to be evolved. The cases are not identical.

LABIOBUCCAL MUSCULATURE

Of greatest importance in the labial and buccal musculature is the interrelation that exists between the buccinator and its associated muscles, the orbicularis oris in front and the superior constrictor of the pharynx behind (Fig. 2). These muscles form a wide elastic band of contractile tissue that entirely surrounds the denture and anchors itself in a mid-point cranial attachment on the basilar portion of the occipital bone, and on the upper portion of the vertebral column through the cervical fascia. These muscles maintain a natural tonicity, and in addition, with every contraction of the buccinator and superior constrictor, exert a backward force on the teeth pulling from an attachment far to the rear of the denture (Fig. 4).

The chief purpose of this arrangement apparently is to antagonize mesial and labial migration of teeth whose constant tendency is to drift forward. Oc-

clusal surfaces of the posteriors, molars particularly, do not meet at right angles to their long axes but instead these teeth have a mesial inclination (Fig. 5). If pressure is applied between two inclined bodies, each tipping in the same direction, there is a resultant component of force in the direction of the inclination. Therefore, with occlusal stress on mesially inclined teeth, there is formed an anterior component force which tends to carry the buccal arch segments forward

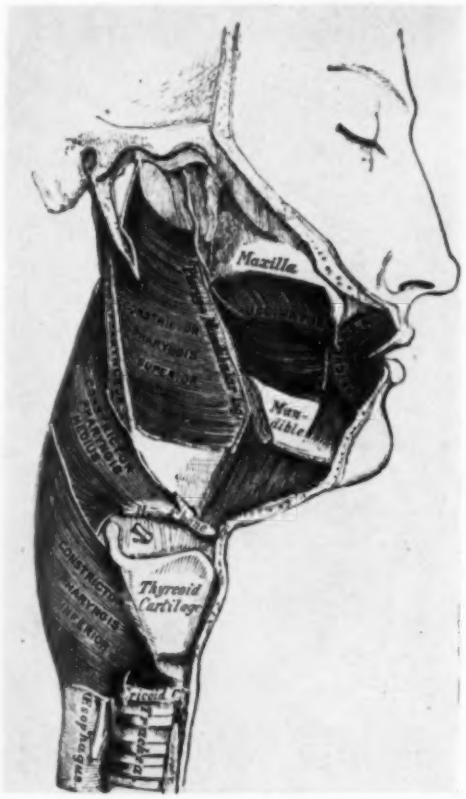

Fig. 2.

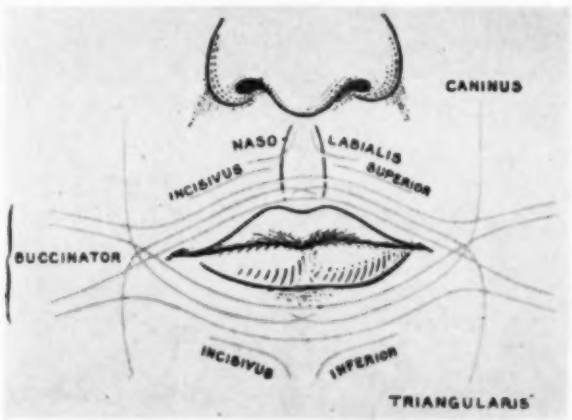

Fig. 3.

Fig. 2.—This illustration shows the relationship between the buccinator and its associated muscles, the orbicularis oris in front and the superior constrictor behind. (From Gray.)

Fig. 3.—A diagrammatic representation of the course of the fibers of the buccinator, caninus, and triangularis, and their insertion into the lips. (From Gray.)

as dictated by the laws of mechanics. The labiobuccal musculature apparently is so designed that, by virtue of its distal pull, it prevents a complete anterior displacement of the dental arches. Moreover, it binds the teeth inwardly into tight contacts, preserves the axial inclinations of the anterior teeth, and prevents undue expansion of the arches. Although this outer muscular pressure acts primarily on the maxillary arch, through the intermeshing of the cusps and inclined planes of the teeth it is reflected in the mandibular arch, which when in occlusion is confined within the upper arch.

The orbicularis oris in itself is not usually considered a sphincter muscle. Being circular in form it is unable to elongate, and its shape is determined by the muscles that insert into it. It consists of a deeper layer of fibers arranged in concentric ellipsoidal rings, and of superficial layers into which all the other muscles of the lips converge.

Of these latter muscles, those of the buccinator are most important. Its upper and lower layers pass directly into the corresponding lips, but its middle fibers decussate or intercross at the corners of the mouth so that the lower fibers enter the upper lip and the upper fibers the lower lip (Fig. 3).

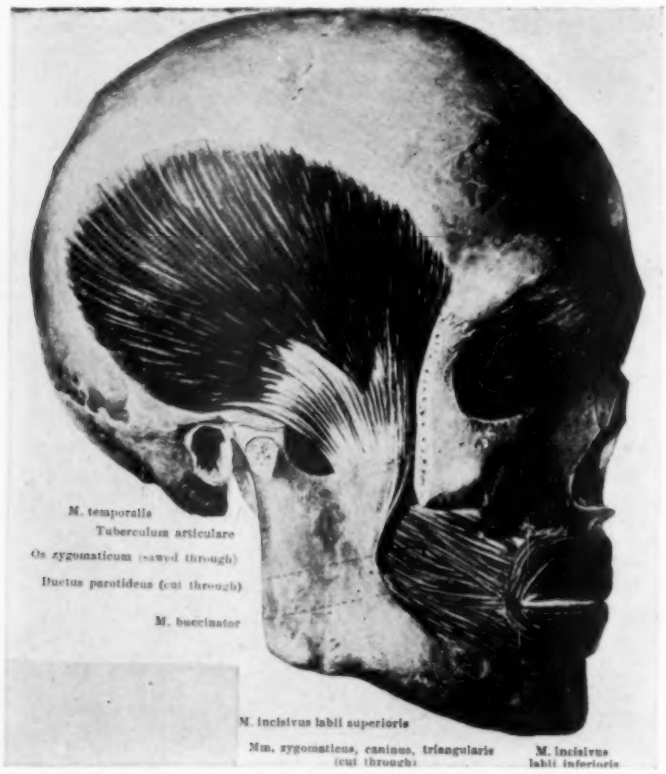

Fig. 4.—The buccinator, orbicularis oris, and temporal muscles. The zygomatic arch has been removed. Note the wide band of musculature surrounding the dental arches. (From Spalteholz.)

Fig. 5.—Semidiagrammatic representation of the anterior component force in a case in which the mesial inclination of the posterior teeth can easily be recognized.

The buccinator's bony attachments are the alveolar borders in the molar regions of both the mandible and the maxilla. Here the muscle forms the greater part of the cheek. Posteriorly it crosses the alveolar arches from buccal to lingual back and around the tuberosity to gain anchorage by an attachment to the anterior border of the pterygomandibular raphe, a tendinous band of connective tissue extending from the hamular process of the sphenoid to

the posterior end of the mylohyoid line on the inner surface of the mandible (Fig. 23).

This raphe forms the anterior boundary of the superior constrictor of the pharynx, which extends backward and inward for its midline cranial and vertebral attachment.

FACIAL MUSCLES THAT INSERT INTO LIPS

Of further aid in preventing a forward displacement of the dental arches is a set of definitely arranged paired muscles whose origins also are posterior to their insertions in the lips (Fig. 6).

Two of these pairs are the canini and the triangulares, which cross each other at the corners of the lips (Fig. 3). The caninus arises from the canine fossa and passes into the lower lip while the triangularis originates from the oblique line of the mandible and passes into the upper lip, each ending in partial union with its mate at the midline. Their combined action is to purse the lips, which also means a lingual pressure on the anterior teeth. Associated with the caninus and extending in nearly the same direction are blending fibers from the quadratus labii superioris. Likewise the quadratus labii inferioris is associated with the triangularis.

The risorius muscle also has a posterior origin in the fascia over the masseter. It extends forward to be inserted into the angle of the mouth and acts to pull the angle distally.

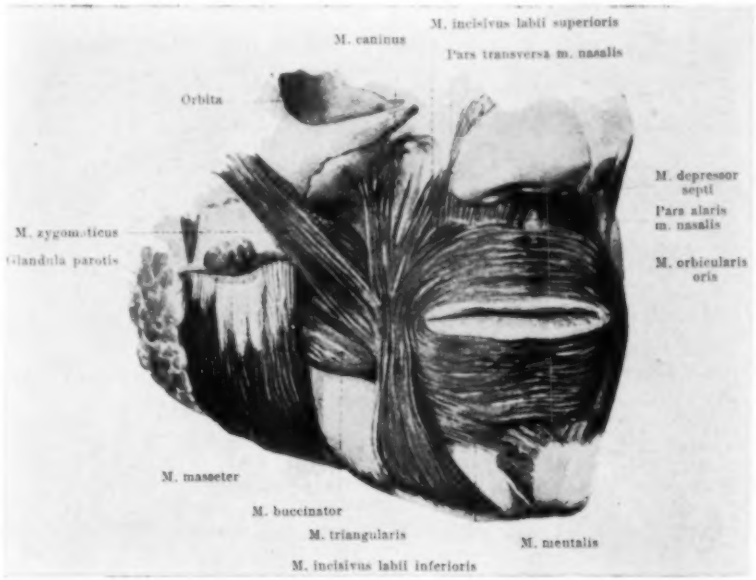

Fig. 6.—Muscles that insert into the orbicularis oris. (From Spalteholz.)

The zygomaticus, because of its lateral as well as posterior origin, acts as a relief muscle in the canine area, and thereby accounts in part for the prominence of the cuspid (Fig. 6). In this action it is assisted by the zygomatic head of the quadratus labii superioris. These muscles arise from the surface of the zygomatic arch, thereby exerting a pull from a base which is wider than that of the dental arch. If this traction was not present, the action of the orbicularis-buc-

cinator-superior constrictor group would tend to produce a merely semicircular arch form in which there was no provision for the anatomically necessary cuspid prominence, as required by the contours of the tooth in its relation to occlusion.

Three other muscles of the mouth of minor importance act to connect the orbicularis oris group to the maxillae and nasal septum above and with the mandible below. They are the incisivus labii superior and nasolabialis in the upper lip and the incisivus labii inferior in the lower lip. A fourth muscle to be considered is the platysma, a broad sheet arising from the fascia covering the upper parts of the pectoralis major and deltoideus. It proceeds obliquely upward along the side of the neck, some fibers of which are inserted about the angle and lower part of the mouth. It serves to draw downward the lower lip and angle of the mouth.

Fig. 7.—Dimpling and pitting of the skin in a patient who presented an overactive mentalis muscle.

Fig. 8.—Characteristic short upper lip pressure on alveolar process during act of smiling.

The mentalis muscle in the chin cannot be dismissed so readily since its frequent overactivity so often complicates orthodontic cases. It arises from the incisive fossa of the mandible and descends to be inserted into the integument of the chin (Fig. 6). Although it is not a muscle of the lip proper, it is important in that, if overactive and hypertoned, it raises and piles up a bulk of tissue pressing on the mandibular incisors, at the same time hollowing out the alveolar process at the apices of their roots. Its overactivity can most easily be recognized by the characteristic dimpling and pitting of the chin when it is contracted (Fig. 7).

In Class II Division 1 cases with short upper lips, closure of the lips is usually effected more by the contraction of the mentalis muscle than by a down-

ward stretching of the upper lip. These cases are further complicated, particularly during smiling, by an excessive lingual upper lip pressure on the alveolar process overlying the roots of the maxillary anterior teeth. This apparently causes a hollowing out of the bony structures in this area (Fig. 8).

Normally the upper lip should lie against the gingival two-thirds of the maxillary anterior teeth, leaving their incisal one-third to be restrained by the edge of the lower lip. Given a short upper lip offering little normal restraint on the crowns of the incisors but instead an increased lingual pressure on their roots, there is little to keep them from achieving an excessive labial inclination. Eventually the lower lip fails to engage their incisal thirds with its restaining pressure and instead exerts an abnormal labial pressure on their crowns from the lingual, thereby further increasing their labial inclination (Fig. 9).

Concurrently that part of the lower lip pressure which normally would have been exerted lingually on the maxillary incisors instead is directed in full on the mandibular incisors. This pressure carries these teeth lingually and often acts as well to elevate them as a resultant component of two opposite forces, that of the inherent forward growth tendency of the incisors as opposed to the excessive backward pressure of the lower lips (Fig. 10). Parenthetically it may be noted that this abnormal elevation and the posterior thrust on the mandibular anteriors may also cause, through contact relations, an intrusion of the mandibular premolars as well, wherein the cuspid crown inclines distally over the first premolar crown, producing a characteristic exaggerated curve of Spee. An overactive mentalis simply aggravates this condition further.

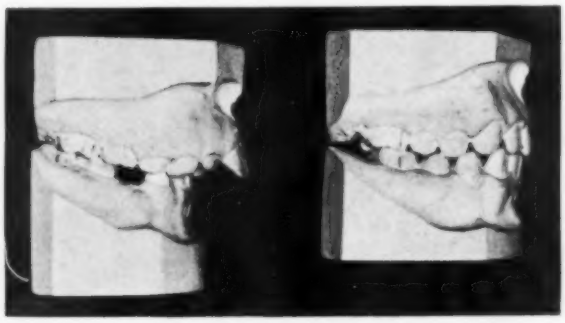

Fig. 9.

Fig. 10.

Fig. 9.—Casts of a marked Class II Division 1 case before and after treatment. Normal lip function obviously was impossible before the correction was made.

Fig. 10.—Lower model presenting an exaggerated curve of Spee with intrusion of premolars and lingual and incisal displacement of the anterior teeth. An overactive mentalis muscle was a contributing factor.

MUSCLES OF THE TONGUE

Although the tongue is a powerful organ, it is not enough in itself to counteract and offset the labial and buccal musculature. The required additional balancing stress comes in part from the orderly arrangement of teeth in continuous contact in an unbroken arch that complies with the mechanical principles of arch design as conceived by the architect (Fig. 11). Thus the teeth normally extend mutual support to each other which enables them in part to resist lingual displacement.

The tongue is suspended from the cranium, the palate, the mandible, and the hyoid bone by a series of paired extrinsic muscles (Fig. 12). One of them is the styloglossus, which arises from the apex of the styloid process of the temporal bone and from the stylomandibular ligament. It passes downward to enter the side of the tongue near its dorsal surface. Its action, together with its mate, is to draw the tongue upward and backward.

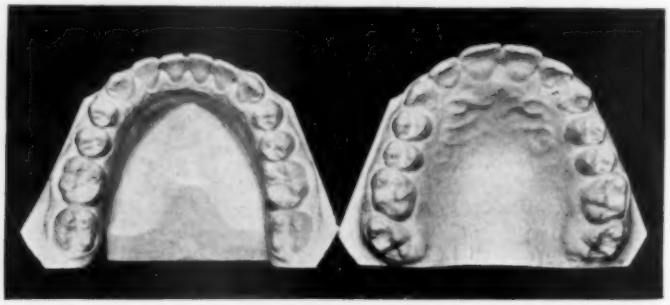

Fig. 11.—Teeth are ideally placed in an arch form that complies with the mechanical principles of arch design.

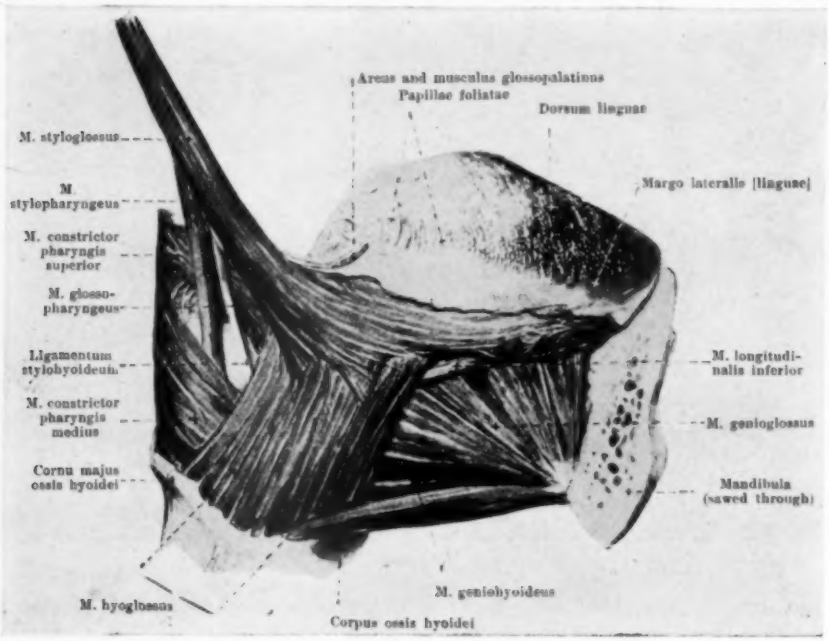

Fig. 12.—The extrinsic muscles of the tongue. (From Spalteholz.)

The genioglossus is a flat triangular muscle, close to and parallel to the median plane which arises at its apex from the upper mental spine on the inner surface of the symphysis of the mandible. It spreads out in a fan-shaped manner throughout the entire length of the under surface of the tongue from the tip to the hyoid bone. Because of their anterior origins, the genioglossi draw the root of the tongue forward and protrude its tip from the mouth. Anterior fibers also are capable of drawing the tongue back into the mouth.

The hyoglossus is thin and square. Its origin is the entire length of the greater cornu of the hyoid bone and it passes vertically upward to enter the side

of the tongue. The hyoglossi depress the tongue and draw down its sides. Action, direction of fibers, and function of the chrondroglossus muscle, only two centimeters in length, are closely related to those of the genioglossus and hyoglossus.

The glossopalatinus is a delicate muscular slip that forms the anterior pillar of the fauces. It arises from the anterior surface of the soft palate and passes downward in front of the palatine tonsil to an insertion into the side of the tongue, some of its fibers spreading over the dorsum and others extending deeply into the tongue to intermingle with the transversus muscle. In addition to their support to the tongue, the glossopalatini act as constrictors of the pharynx during deglutition.

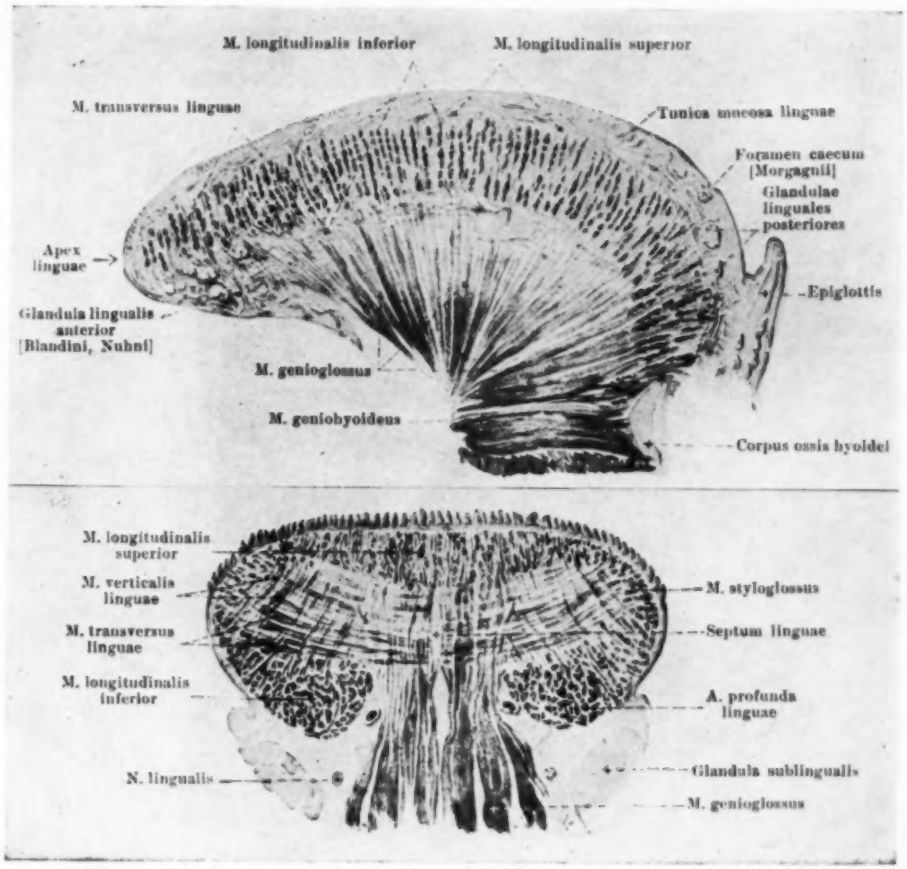

Fig. 13.—The intrinsic muscles of the tongue. (From Spalteholz.)

In addition to these extrinsic muscles, the tongue contains an involved intrinsic group mainly concerned in altering its shape, whereby it becomes shortened and widened, extended and narrowed, or curved in various directions (Fig. 13). Two of these are the longitudinalis superior and the longitudinalis inferior. The superior muscle is a thin layer underlying the mucous membrane of the dorsum of the tongue extending forward from the epiglottis to the edges of the tongue. It tends to shorten the tongue and turn the tip and sides upward to render the dorsum concave.

The longitudinalis inferior is a narrow muscle band on the under surface of the tongue extending from its root to the apex. It also tends to shorten the tongue but it pulls the tip downward to render the dorsum convex.

The two other intrinsic muscles are the transversus and the verticalis. The transversus arises from the median fibrous septum and passes laterally to the sides of the tongue. It narrows and elongates the tongue. The verticalis is located at the borders of the anterior part of the tongue, its fibers extending from the superior surface to the inferior. This muscle flattens the tongue.

This intricate arrangement of tongue musculature, primarily under the influence of the will, can give rise to a variety of deformities that in a high-strung individual may mean failure in attempts at correction. Perversion of tongue position upsets the equilibrium that normally exists between it and the muscular pressure outside the dental arches, thus resulting in unnatural forces on the teeth and their supporting bony structures.

Apparently the most normal tongue position is with the tip resting against the lingual surfaces of the mandibular incisors and the body of the organ arched up and back against the palate. Although it may remain in continuous contact with the palate, generally a space develops between the two. There is little positive evidence that a vacuum always occurs in this area. It is when the tongue fails at least approximately to occupy this general position that characteristic irregularities are found to occur.

Fig. 14.

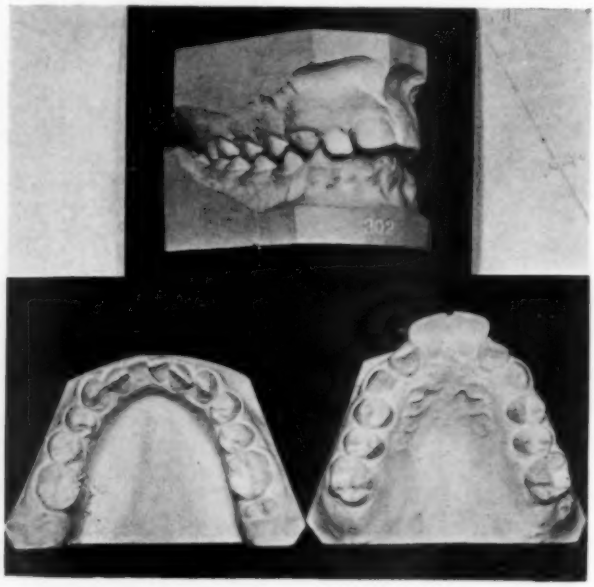

Fig. 15.

Fig. 14.—Characteristic facial outlines of the mouth-breather.
Fig. 15.—Casts illustrating disharmony that results from mouthbreathing.

The mouth breather is a typical example. As the mandible drops open, it carries the tongue with it (Fig. 14). This action relieves the maxillary teeth of the natural support of the tongue and mandibular teeth, but the labiobuccal musculature continues to exert its lingual pressure on the upper arch, resulting in a contraction of this arch particularly in the area near the angles of the mouth

where the stress is greatest (Fig. 15). This means either crowding or protrusion of the maxillary anterior teeth and occasionally cusp-to-cusp occlusion of the premolars. The change in position does not stop until there is an equalization of the forces within the arches as opposed to those from without.

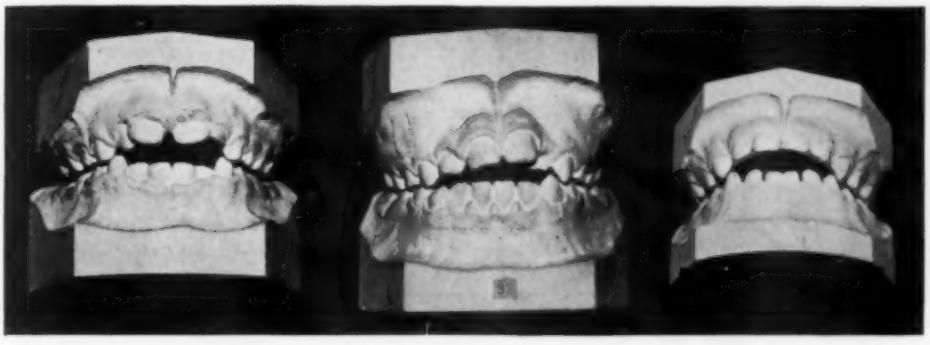

Fig. 16.—Series of casts showing typical results of anterior tongue thrusting.

Fig. 17.—Three photographs illustrating tongue position when thrust between the teeth, thereby preventing their full eruption.

Tongue thrusting is another common form of muscular unbalance. If thrust completely between the anterior teeth to the lips it may cause a local condition of infraclusion known as open-bite (Fig. 16). This occasionally occurs on one side

of the arch only (Fig. 17). Often the molars in their attempt to regain occlusal contact, tend to elongate, with a resultant supraclusion of these posterior teeth.

If the tongue is simply thrust against the anterior teeth, as in an abnormal swallowing habit, it may cause a larger cuspid-to-cuspid arc than is normal, with a resulting labial tipping of individual teeth and spacing between them (Fig. 18). With good lateral function on the posterior teeth, these buccal segments then tend to drift mesially with an ultimate complete anterior displacement of both arches.

The genioglossus muscle is probably the agent generating this forward thrust of the tongue, and the transversus is likely to contribute if the tongue is narrow and elongated as is often found when this organ is thrust between the maxillary and mandibular incisors.

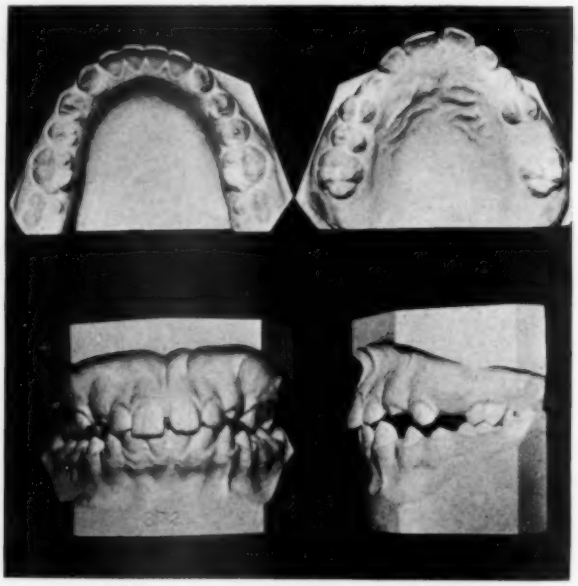

Fig. 18.—Casts of a case in which the tongue habitually pressed against the lingual surfaces of the anterior teeth, causing spacing and labial tipping.

Clinical observation demonstrates that in most Class III cases the tongue habitually rests on the floor of the mouth beneath the level of occlusal contact. It lies in this position in a lazy, inactive manner, its dorsum flattened, and seemingly incapable of normal activity. No support is given to the maxillary arch. As if in an attempt to escape this tongue pressure, the mandible may relax in a position anterior to normal. It often appears to be hollowed out on its lingual aspect below the gingival margins of the teeth, with a typical lingual inclination of all the mandibular teeth (Fig. 20).

As a result of mandibular protrusion, the mandibular anteriors, lacking their normal antagonists, continue past the occlusal plane into supraclusion (Fig. 19). Lip action normally intended for maxillary incisors now engage the mandibular anteriors to tip them lingually. Completing the mandibular picture, the premolars are carried buccally to give the arch an ovoid appearance. And with mandibular protrusion, the muscles of mastication that are attached to the ramus apparently exert a greater pull on the angle of the jaw, with the result that the angle becomes more obtuse than is normal.

Lacking normal lingual supports, the maxillary teeth drift lingually until some sort of a balance is struck between the labio buccal musculature and what little force remains to offset it from the lingual. When the maxillary arch is so contained within the lower arch, it is further restrained from attaining its full development because of its abnormal lingual relation to the lower during occlusal function (Fig. 20).

Most of these tongue malpositions are the result of habit in which the patient places the tongue in a manner that, to him, is natural and most comfortable. Unfortunately, the marked muscular unbalance that results requires full functional correction simultaneously with mechanical correction if permanent success is to be achieved. As a rule, greater difficulty arises in these cooperative functional corrections than in actual appliance manipulation. There seems to be little ability of the extrinsic muscles to raise the tongue or of the intrinsic muscles to effect its arching upward in a convex manner. In some cases, the tongue may take its unnatural positions because the mandible is altered from other causes, but as a rule it appears to be more likely that tongue position is the cause of these conditions and not the effect.

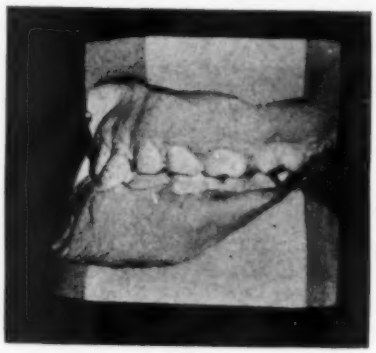

Fig. 19.

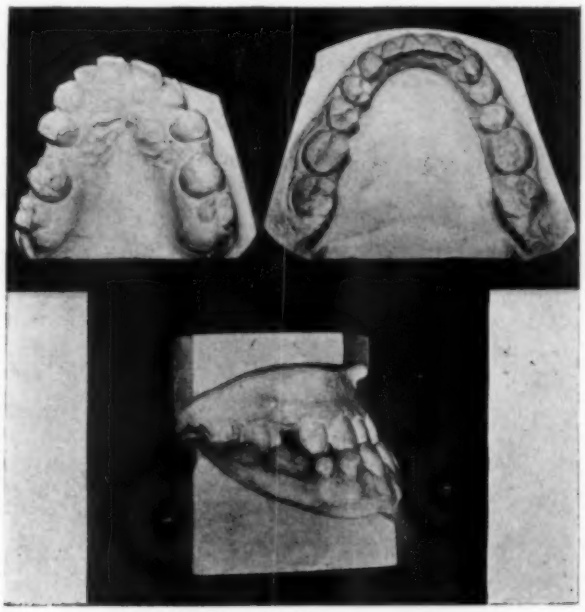

Fig. 20.

Fig. 19.—Class III case demonstrating extrusion and lingual tipping of mandibular anterior teeth caused by improper muscular balance.

Fig. 20.—Typical Class III case illustrating disharmony in arch size and relationship.

LIGAMENTS AND MUSCLES OF THE MANDIBLE

The muscular groups that direct the movements of the mandible during function are known as the muscles of mastication. The mandible is the only movable bone of the head, being suspended by a series of ligaments as well as muscles. Its direct attachment to the cranium is through a nonbony union known as the temporomandibular articulation, a gliding hinge joint formed by

the condyle of the mandible and the glenoid fossa and eminentia articularis of the temporal bone (Fig. 21).

Between the condyle and fossa, which are connected by a loose envelope called the capsular ligament, is a thin disc, the meniscus, or articular disc. Extensive mandibular movements are permitted by the articulation—depression, elevation, protrusion, retrusion, and side to side masticatory motions. The meniscus, together with the condyle, slides forward during function from the glenoid fossa onto the eminentia articularis and back again. Effectively assisting these parts in preventing displacement of the mandible are three other ligaments, the sphenomandibular, stylomandibular, and temporomandibular, the names of which indicate their origin. Attachments respectively are on the inner and posterior surfaces of the ramus and on the outer surface of the neck of the condyle.

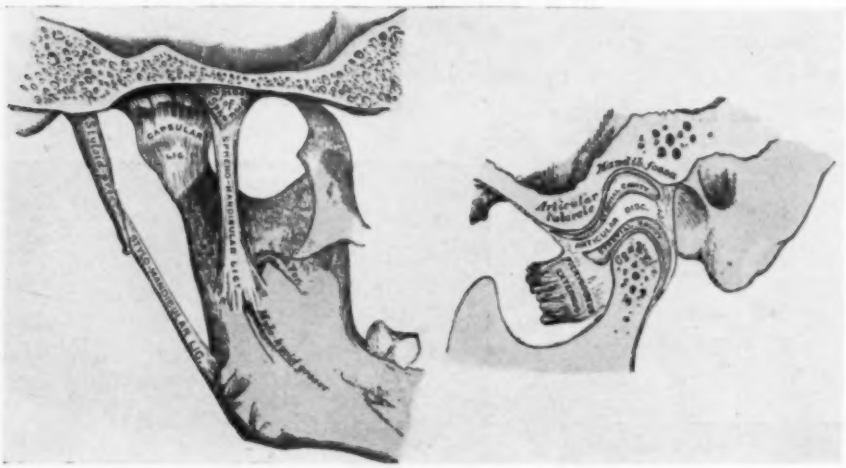

Fig. 21.—Ligaments of the mandible, from the lingual. The temporomandibular ligament, not shown, is on the lateral surface of the neck of the condyle. (From Gray's Anatomy.)

The muscles produce their effect primarily through occlusion of the teeth and the resulting pressure on the bony supports. Active and vigorous masticatory muscles bring about normal development of facial bones, creating osseous density and structure in accordance with Wolff's theory of the mathematics of bone design. Definitely applicable if abnormal function of these muscles is involved is Wolff's Law of the Transformation of Bone: "Every change in the form and function of a bone or of its function alone is followed by certain definite changes in its internal architecture, and equally definite secondary alterations in its external conformation in accordance with mathematical laws."

The muscles of mastication supply the principal means of support for the mandible. Superior attachments of these muscles are on the face or cranium, with their insertions on the posterior surfaces of the mandible. Of these the masseter, temporal and internal pterygoid raise the mandible to force the mandibular teeth against the maxillary. The external pterygoid carries forward and depresses the bone by pulling the meniscus and condyle forward onto the eminentia articularis.

The internal pterygoid is a thick quadrilateral muscle arising from the inner surface of the lateral pterygoid plate and the pyramidal process of the palatine bone (Fig. 22). A second slip arises from the lateral surface of the pyramidal process and the tuberosity of the maxilla. It passes downward, backward, and somewhat lateralward to be inserted into the inner side of the ramus and the angle of the mandible.

The masseter consists of two layers, the external being the longer and broader. This portion arises by a thick tendon from the anterior and middle part of the zygomatic arch. It extends obliquely backward and downward to the angle and lower half of the outer surface of the ramus of the mandible. The internal smaller layer arises from the inner surface and posterior third of the lower border of the zygomatic arch. Its fibers pass downward and somewhat forward to be inserted into the upper half of the ramus (Fig. 24).

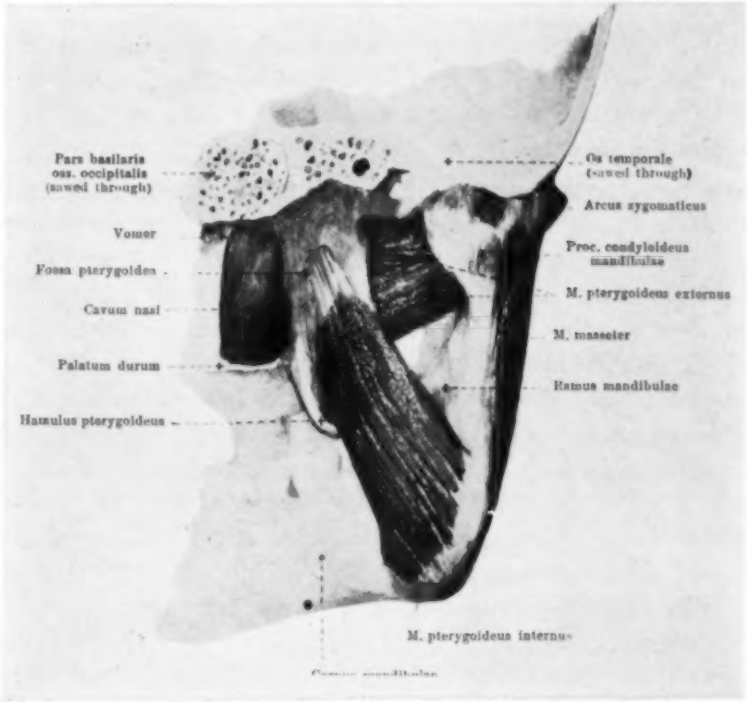

Fig. 22.—The masseter, internal, and external pterygoid muscles. (From Spalteholz.)

Thus the direction of the masseter fibers on the outer surface of the mandible closely parallel those of its companion muscle, the internal pterygoid, on the inner surface. The direction of pull is upward and slightly forward. Together these two strategically placed muscles on either side of the mandible may be likened to an elastic hammock or swing into which the mandible is suspended from the cranial structures above (Fig. 22).

The temporal is a fan-shaped muscle arising from the whole extent of the temporal fossa well up on the side of the head. From this broad origin the fibers descend to end in a tendon which is inserted in the inner surface, apex, and anterior border of the coronoid process of the mandible (Fig. 4). Anteriorly the

fibers are vertical; the posterior at first are almost horizontal, then markedly curved. Besides elevating the mandible, it draws the coronoid process, and thus also the condyle, somewhat backward.

The external pterygoid is a short, thick, somewhat conical muscle extending almost horizontally from the condyle to the pterygoid process (Fig. 23). Its main action is to draw the mandible forward. Its origin is from two heads—the upper and smaller from the lower part of the lateral surface of the great wing of the sphenoid and the infratemporal crest, and the lower from the lateral surface of the lateral pterygoid plate. The fibers converge outward and backward to be inserted into a depression on the anterior surface of the condyle and into the anterior margins of the meniscus.

In addition to drawing the condyle and meniscus forward, and thus the entire mandible, the external pterygoids assist in opening the mouth. When the internal and external pterygoids act on one side only, that side of the mandible is carried forward while the opposite condyle remains comparatively fixed.

In pulling the mandible upward and forward against the maxilla, the pterygoid muscles indirectly exert a downward and backward stress through their attachments on structures approximating the upper jaw, so that their influence in part is felt by the maxilla.

Lacking a direct attachment to the cranium which would aid in its forward development as is found in maxillary relations, the mandible is dependent on strong masticatory function and cuspal interdigitation to bring about its complete development. Herein the masticatory muscle group offers a living orthodontic mechanism of great efficiency, which with good function is retentive as well as developmental in character.

These muscles, with the buccinator, also aid in bracing the distal ends of the dental arches so that tight contacts can be maintained by preventing a distal drifting of the molars. During function there is a forward squeezing action of the temporal, internal pterygoid, and masseter that can easily be tested by placing a finger in the mouth on the anterior edges of one of the masseter muscles and noting the forward push that is given as the teeth are forced together. Equally effective is the pressure brought to bear by the buccinator during function as it crosses the dental arches distally to the last molar. These muscles achieve their forward squeezing action by being wedged or bunched between the molars and the ramus of the mandible, which supports or backs them up posteriorly.

HYOID MUSCULATURE

The mandible also acts as one of the supports of the hyoid bone through the suprahyoid muscular group, and this bone in turn supports the larynx and throat musculature (Fig. 25). Further support to the hyoid is given by a pair of muscles that extends up, back, and laterally to gain attachments on either side of the cranium, thus completing a three-point suspension for the bone. Continuing downward is the infrahyoid group that extends on to the thorax. Thus there is provided in the masticatory and hyoid groups a muscular system extending from the cranium to the thorax in front that counterbalances or antagonizes a powerful group of posteervical muscles in back extending downward

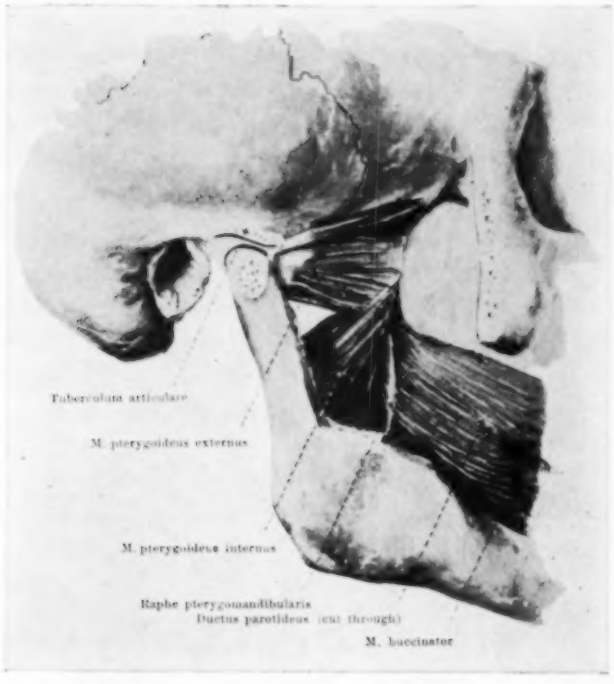

Fig. 23.—The internal and external pterygoid muscles. Note also how the buccinator swings back and in for its attachment to the pterygomandibular raphe. (From Spalteholz.)

Fig. 24.—The masseter and temporal muscles. (From Spalteholz.)

from the occipital bone. The difference lies in the fact that the postcervical group is concerned primarily with the maintenance of an upright position, whereas the anterior group in addition must care for the functions of mastication, deglutition, respiration, and speech. If this anterior musculature were not present, the postcervical group, unopposed, would act to tip the head backward.

Anterior attachments of the suprahyoid muscles for the most part are located near the symphysis, which means a distal drag on the mandible in its developmental efforts. Undoubtedly compensation is made for this through the counterbalancing efforts of those masticatory and associated muscles so placed as to encourage mandibular development and maintenance during function, and in the inherent forward growth program that Nature attempts to follow for this bone.

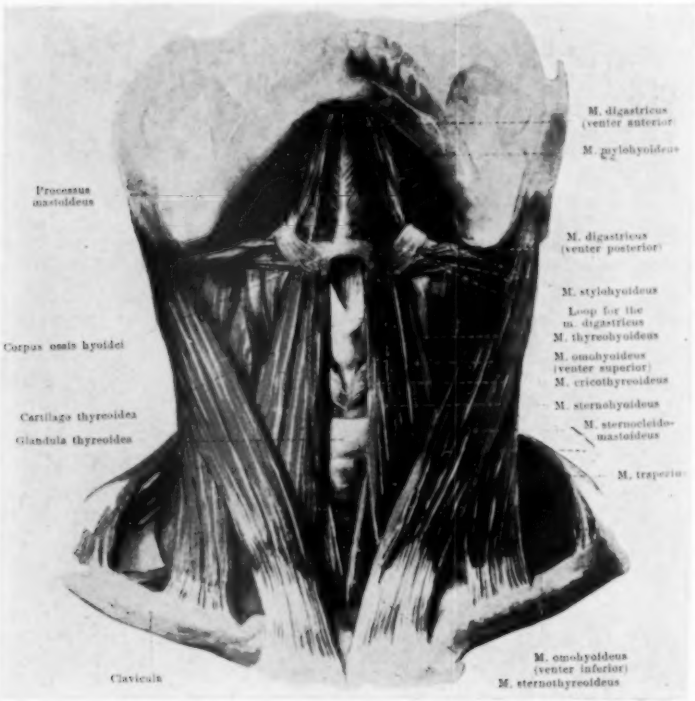

Fig. 25.—The muscles of the hyoid bone, with their mandibular attachments. (From Spalteholz.)

The suprahyoid muscles are the stylohyoid, mylohyoid, and the geniohyoid, whose names indicate their origin and direction of fibers, and also the digastric. This latter muscle has two bellies, the posterior passing downward and forward and originating at the mastoid notch of the temporal bone, and the anterior, which originates in a depression on the inner side of the lower border of the mandible and extending downward and backward. These two parts are connected by an intermediate tendon which is held to the side of the body and greater cornu of the hyoid bone by a fibrous loop.

The infrahyoid muscles, located below the hyoid bone, are the sternohyoid, sternothyroid, thyreohyoid, and the omohyoid. Their interest lies in their ability to "fix" or hold the hyoid bone in a stationary position when the supra-

hyoid muscles are active, and in depressing the larynx and hyoid bone after they have been raised with the pharynx during deglutition.

CONCLUSIONS

Proper examination of all the habits and perversions that may be associated with facial and masticatory musculature obviously cannot be given within the limits of a paper whose primary purpose is to observe the normal in order that deviations can more easily be recognized. Nor can proper treatment be made of such involved processes as deglutition, respiration, speech, or extraoral influences, all of which have a direct bearing on facial growth, development, and maintenance. Inquiries also are in order into the effect that tissues of the soft palate, the pharynx, and the osseous structures of the head have on the functions of the immediate musculature affecting the face and denture. These subjects in their own right are worthy of full-length studies.

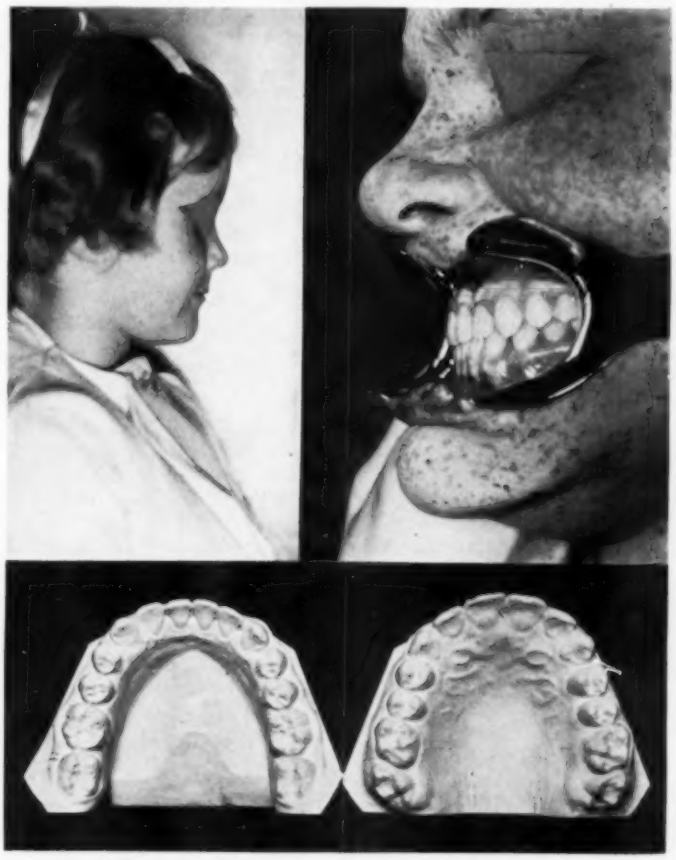

Fig. 26.—These photographs are included to illustrate the ideal in dentofacial structures. Note the normal occlusal relationships, facial contours, and arch form.

However, certain conclusions can be made from this study about the effect of musculature on dental growth and maintenance. They are:

1. Normal dental and facial development depends to a great extent on normal muscular function (Fig. 26).

2. Normal dental development and maintenance involve an equalization of forces between the labiobuccal musculature outside the arches and the tongue within.

3. Arch form and the "anterior component force" aid the tongue in antagonizing the outer layer of musculature.

4. Teeth tend to move in the line of least resistance. This is possible because bone tissue readily responds to pressure. Normal balance of all the muscular forces that play on teeth is therefore necessary if normal dental and facial contours are to be achieved.

5. Muscular perversion results in movement of teeth in various directions in an effort to find a position in which the distorted forces establish a new balance. This abnormal balance will have the characteristics of a dental or facial deformity, depending on the nature and extent of the muscular perversion.

6. Since the mandible is suspended by two sliding hinge joints, its development is more dependent on normal muscular function and occlusion of teeth than that of the maxillae, which are aided in their growth by a more direct bony cranial attachment.

7. Strong vigorous muscles are of the greatest importance in developing and maintaining normal dental and facial structures. When balanced they are perfectly designed to achieve this ideal. On the contrary, if unbalanced, they are powerful agents in destroying normal occlusion of the teeth and pleasing symmetry of the facial structures.

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THE INFLUENCE OF THE FORMATIVE DENTAL ORGANS ON THE GROWTH OF THE BONES OF THE FACE*

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INTRODUCTION

THE most striking feature of the human skull at birth is the diminutive size of the bones of the face as compared to the skull as a whole. Indeed, these fourteen bones are so overshadowed by the comparatively great size of the dome of the skull as to appear stunted and deformed. Another remarkable thing about the facial skeleton is its rapid growth during childhood and adolescence. During this period these bones develop so rapidly in all three dimensions that by maturity they have "caught up" with the other growing bones of the skull and we have a harmonic whole. These conditions are depicted in Fig. 1, *A* and *B*.

The unequal growth rate of these two portions of the skull can only be accounted for by the fact that the facial part possesses during its period of rapid enlargement, and only then, a growth mechanism peculiar to this stage of development. No such mechanism exists at any other time and no such growth acceleration is found in any other part of the skull. An attempt to study the nature of this growth activator is the basis of this report.

SOME HISTORICAL FACTS

While it is not strange that the ancient anatomists made no mention of the unequal growth rates of these two groups of bones, it is surprising, nevertheless, that they recorded nothing regarding the spectacular morphologic peculiarities of the facial skeleton at birth.

Cheselden, in one of the earliest studies on the relative growth of human bone, made no mention of the differences in growth rate between the bones of the face and the cranium. Yet in his *Anatomy*[1] published in 1733 and famed for its plates, he depicted these conditions in a drawing of the skeleton of an infant, as accurately as is shown in the referred-to photographic illustration of the skull at birth. Even the extreme recessive position of the framework of the face, so characteristic of that age, was represented. Nevertheless, his only reference to the skull-growth is its relatively large size as compared to the rest of the skeleton. It is equally surprising that Cheselden's observing pupil, John Hunter, who made such a careful study of this region in man and the lower animals, in the preparation of his famous treatise on the teeth and their supporting structure,[2] published in 1771, only alluded to it, although he revealed much truth about the growth of the mandible.

It was not until about the middle of the nineteenth century when the theory of evolution was gaining its foothold that attention was directed to the unequal

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growth-rate of the face and cranium, and Froriep[3] pointed out in 1845 the difference in the growth-ratio of the bones of the face and the cranium. He believed that this increase in facial size was due largely to the unusual growth of the teeth-bearing bones, the maxilla and mandible, resulting from the growth, development, and function of the teeth themselves.

Since Froriep other anatomists and anthropologists have carried these studies further and proved the validity of this belief. Furthermore, they have pointed out that similar conditions occur in the anthropoid group and other mammals. More recently orthodontists have contributed much to this study. Yet all these labors have been directed largely to show *how* the bones of the face grow. Comparatively little work has been done on *why* they grow. It is the latter phase of the problem on which I have directed my endeavors. What has been accomplished was made possible only because I succeeded in locating the site of the growth power within the formative organs of the teeth and thus was able to study this growth force apart from the other developmental influences.

Fig. 1.—*A*, Skull at birth. *B*, Skull of a young adult. Note that in *A* as yet there are no teeth and little development of the bones of the face. In *B*, observe the extensive growth of the face which accompanied the development and eruption of the teeth. (The photograph of the skulls is according to scale.)

PREFUNCTIONAL AND FUNCTIONAL INFLUENCES

It must be understood that the developmental factors common to bone growth in general have their influence on the growth of the group of bones under investigation. That both the functional influences[4] and the growth tendencies inherent[5] within bone itself play a role in this growth has not been overlooked may be gathered from my previous writings. An excellent account of these functional experiments may be found in a digest by James C. Brash.[6] Mention must be made that no less an authority than Sir Arthur Keith stresses the fact that the function of the muscles of mastication is an important factor in skull form.[7]

OBSERVATIONS AND DISCUSSION

Observations regarding the influence of the formative organs of the teeth on bone growth began during my referred-to studies of prefunctional influences upon the behavior of transplanted fetal rat mandibles. It was found when

embryonic rat mandibles were transplanted into the leg muscles of mother animals that after the peak of prenatal development was reached, and the bone pattern was formed, as is illustrated in Fig. 2*A*, resorption set in. (Evidently, as suggested by the anthropologist, Dr. Earnest A. Hooton, when the bone had been shaped by the inherent growth influences, the development from then on was continued largely by the functional stimulus of the muscles.) The remarkable thing about the resorption was that it seemed to operate according to a

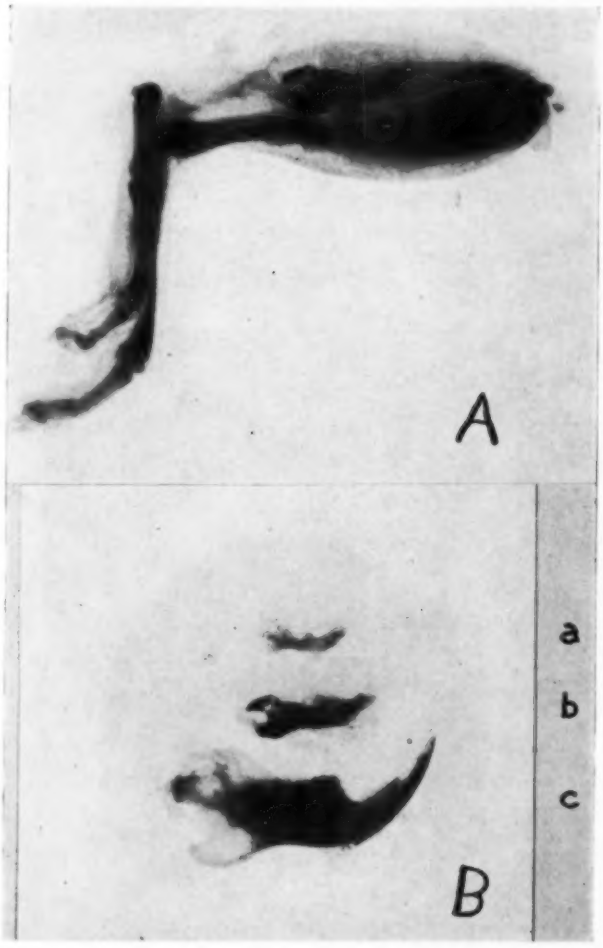

Fig. 2.—*A*, Embryonic rat mandible transplanted into leg muscle of the mother animal at the peak of prefunctional development (forty days). *B*, *a*, Lateral half of the mandible, taken by cesarean operation, three days before birth, at time of transplantation. *b*, Other half of the same mandible after forty days of implantation in leg muscle of the mother animal, showing prefunctional development at its height. *c*, Mandible of litter mate born normally three days later after forty-three days of functioning.

Observe that the transplanted mandible *b* is approximately one-third larger than *a*, and that the litter mate *c*, born naturally three days after *b*, grew to be about twice the size of the transplanted mandible.

definite scheme or law. Invariably the part of the bone to which the muscles would have been attached gradually disappeared because the functional stimulus was wanting. But that part of the body of the bone containing the formative organ of the continuous growing incisor remained. It was evident that the forming organ of the persistently growing tooth possessed a power of growth greater at that time than that of the bone itself. I suspected that this growth of the

teeth might be responsible for the acceleration in the growth of the mandible and the maxilla during the development and eruption of these organs. Realizing that here might be the cause of the growth phenomenon, the results of which Hunter, Froriep, Keith, Todd, Broadbent, and others had studied, I followed out this clue.

EXPERIMENTS ON THE RODENT

The first experiment was to remove from a series of three-week-old rats the formative organ of one upper incisor,* the tooth itself being allowed to remain. The incisor on the other side was, of course, allowed to grow normally, thus producing a unilateral condition the results of which are shown in Fig. 3, *A* and *B*. Photograph *A* is of the skull of one of these animals four months after the removal of the formative organ of the left incisor, while *B* is of the skull of the other animal seven months and one day after the removal of the organ from the right one. Both teeth operated on were, as already pointed out, allowed to remain; thus the growth resulting from the functional influences was interfered with as little as possible.† It will be noted that an extraordinary

Fig. 3.—The deformity in these two rats' skulls was caused by the aspiration of the formative organs of one incisor. In *A* the left organ was removed, while in *B* it was the right. Observe the lack of growth of the face bones on the side where the growth of the tooth was inhibited.

unilateral bony arrest resulted. In each rat the face bones were twisted toward the side from which the formative organ was removed, and in the direction of their line of growth.

It is remarkable that a tiny embryonic-like mass, less in size than a rice grain, the function of which was supposedly solely for the continuous growth and eruption of one single tooth should contain a growth power, the reaction of

*These formative organs were taken out with the greatest of care so as not to injure the adjacent parts, the tissue itself being removed by suction, while the removal openings in the crypt wall were made just large enough for the introduction of the point of the aspirating needle. To make sure that the bone removed was in no way responsible for the deformity, similar openings were made in the crypt wall of these teeth in another group of rats of the same age, the formative organ itself being, of course, undisturbed. No deformity resulted. We are, therefore, reasonably sure that the changes in the bony structure here shown were due to the removal of the formative organs themselves.

†To ascertain whether or not the removal of the pulp interfered with the function of the tooth sufficiently to be a contributing factor to the deformity, the function of one upper incisor was eliminated for the same period of time in another series of young rats by frequently cutting off the occlusal end of the tooth. No appreciable deformity resulted.

which can so profoundly modify the shape of every one of the fourteen bones of the face. Indeed, the deforming influence did not stop there, but extended even to certain bones of the cranium!

It must be admitted that very little is actually known about the growth power we are studying. Even its nature is such that we are unable to measure it. We are also ignorant as to whether this activating power lodged within each forming dental organ is a mere mechanical force or a biologic one, possibly activated by some unknown hormone. Either may play its part. It does appear, however, as shown by this experiment as well as those to follow, that it must be considerable and in certain respects resembles the force in growing plant rootlets which Dr. Philip R. White of the Rockefeller Institute for Medical Research has found to be so profound.

Fig. 4.—The deformity of this rat's mandible was caused by the aspiration of the formative organ of the right incisor. Note excessive shortening of the body of the bone which carried the tooth whose growth was inhibited.

Dr. White has recently reported that in his sap pressure experiments with tomato-plant rootlets,[8] the force generated was so great that he was unable to record its full pressure, for his apparatus broke down at 90 pounds per square inch. It is his opinion, nevertheless, that the power generated is much greater and may amount to 350 pounds per square inch, which is more than that generated by many high-pressure steam boilers. White's work suggests that there may be some intercellular hydrokinetic action involved in our problem as there undoubtedly was in his. The finding of considerable serous-like fluid in the bony crypt of the developing teeth and the fact that these structures are confined within bony walls is very suggestive in this connection.

In another group of rats we applied the same experiment to the mandibular incisor. Fig. 4 shows the result characteristic of the group. The unilateral arrest in the growth of this mandible indicates that it was from the right incisor that the pulp was removed. Again note the lack of development occurs in the anteroposterior direction, the direction of the growth line of the tooth. These results were brought about within approximately three months after the removal of the formative organs of the tooth. The excessive shortening of the body of the

bone on the side which carries the incisor from which the pulp was removed was striking and, considering that the duration of the experiment was considerably shorter than the first one, the deformity produced compares well with that of the other bones of the face brought about in the previous experiment.

Too much comparison must not be drawn between this work on the ever-growing teeth and what takes place in the human, because of the dissimilarity of these organs. It was necessary, therefore, to carry these investigations to animals whose dentitions resembled man's, in that the teeth ceased growing when fully formed, and which also had both deciduous and permanent teeth, as in the carnivora.

EXPERIMENTS ON THE CARNIVORA

The first of the second series of experiments was performed on the cat. Kittens were selected at the age of weaning. All of the permanent teeth germs present at that time in the right maxillary bone were removed by aspiration.* As great care was taken during this operation as the ornithologist exercises in blowing his rarest of eggs. Very small removal openings were made so as not to destroy any more of the crypt wall than possible and great precautions were taken during the removal process not to injure either the closely associated orbital floors above or the adjacent roots of the temporary teeth below. The experiment extended over a period of two months and nine days. It terminated then for two reasons: First, the temporary teeth showed signs of loosening and, if shed, the resulting lack of function would spoil the experiment; and second, because the animal showed symptoms of muscular paralysis (see footnote, page 497).

It will be noted in Fig. 5 that the result of the experiment was an asymmetric growth of the bones of the face. The lack of growth occurred on the right, the side from which the propelling forces of the teeth were removed; and the arrest in growth was essentially vertical, the direction through which the forces acted. It will be observed that the body of the right maxillary bone has grown so little in the vertical direction that in this plane it is still in its "infantile" state of development.† It will be further noted that there is a cor-

*Undoubtedly the deciduous dentition also exerts a growth influence on the facial bones. Unfortunately its power cannot be studied by this method, for if these tooth germs were removed from one side, the teeth would not erupt and there would be no function on that side until at least the permanent teeth came to place. The resulting unbalanced function would undoubtedly have an appreciable effect on the growth of the maxillary bone and so would affect the result of the experiment.

†There are, of course, other causes for the retardation of facial growth aside from the removal of the growth power we are studying. Anything which inhibits bone growth in general retards to a more or less degree the growth of the facial skeleton. The literature on endocrine disturbances and vitamin deficiencies gives abundant evidence to support this fact.

Brash in dealing with these and other causes as they apply to the retardation of facial growth in his already referred-to work, "The Aetiology of Irregularity and Malocclusion of the Teeth"[9] cites many examples. Among those due to vitamin deficiencies (see pp. 140-145), he shows the results obtained by Dr. Percy R. Howe in vitamin C deficiency experiments[10] with animals, one of which is depicted in Figs. 123-124. This specimen, the skull of a monkey which was fed a scorbutic diet since the animal was young, shows a marked facial arrest. Although the lack of this vitamin inhibits the skeletal growth of the animal in general, according to Howe, it affects particularly the growth of rapidly forming bone; and it would appear also to have a similar retarding influence on the growth power within the forming organs of the teeth as well.

As a matter of fact, the development of the teeth was so retarded as shown in the anterior view of the skull, Fig. 123 (Brash's Aetiology), that the roots of the teeth never formed and these structures failed to erupt, the crowns remaining in their original positions directly under the orbital and nasal floors. Coincidental with this, the facial bones grew so little that the skull retained the appearance of that of a young animal. Undoubtedly, the "infantile" appearance of the facial structures is primarily due to the inhibition of the same forces I am studying in isolation from the other growth factors—the power within the formative organs of the teeth.

For other similarities between Howe's work and mine, see footnote on page 501.

related asymmetry of the positions of the orbits. The orbit on the right, the side from which the lifting power of the descending teeth was removed, is on a lower level than the one on the unoperated side, and there is a corresponding flattening of the frontal bone, sufficient to affect the shape of the cranial vault. Had we been able to continue the experiment until the animal was full grown, the deformity would undoubtedly have been even greater.

There is a remarkable similarity between the result of the experiment on the rodent and this one on the carnivora in that the arrest in growth occurred in the direction of the growth of the teeth. In the rat the persistently developing incisor grows in a forward direction and the resulting deformity is in the horizontal plane. In the cat, the maxillary teeth grow in a downward direction, and the arrest in growth is in the vertical plane. (Compare with results in pig experiments, p. 505.)

Fig. 5.—Showing the influence of removing from the right maxillary bone of a kitten all the formative organs of the permanent teeth present at the age of weaning. The experiment extended over eight weeks and two days. Note the resulting lack of bone growth on the experimented-on side.

KEITH'S THEORY

Sir Arthur Keith, probably more than any other living man, appreciates the bone growth influence of the eruptive forces of the teeth. As far back as 1902, in one of his studies on the growth of the internal structures of the face, he presented a theory as to the influence the erupting teeth exert upon the growth of the maxillary sinus and other facial structures.[11] Here he points out:

> "While a full account of the growth of the lower jaw, and the relationship of its growth to the eruption of the lower permanent molar teeth, can be gathered from the writings of John Hunter, Tomes and Humphrey, I have been unable to discover in recent medical history any detailed account of the growth of the upper jaw, and the manner in which accommodation is found for the upper permanent molars, or of the way in which these teeth are brought into place. Nowhere is there to be found a clear expression of the relationship that exists between the growth and expansion of the maxillary sinus (antrum Highmore), and the migration and eruption of the upper permanent molar teeth. If the

views put forward in this paper are right, then it will be seen that the growth and age changes in the lower jaw are correlated with, but secondary to, the growth of the upper jaw, and development of the maxillary sinus."

The illustration for Fig. 6 is taken from Keith's paper. It is evident from this drawing and its description as well as from the text, that Keith realizes that the propelling forces of the teeth are very great and have much to do with the forward and downward growth of the facial part of the skull. He makes it clear that the growth paths of the teeth, particularly those of the molars, describe the arcs of circles and that, as each one of these three teeth successively sweeps through its arc of growth, there is an elongation of the maxillary bone and an increase in the size of the maxillary sinus. And as he says, "The body of the bone [sphenoid], the anterior border of its great wing, and its pterygoid processes form the fulcrum on which the growth of the upper jaw takes place."

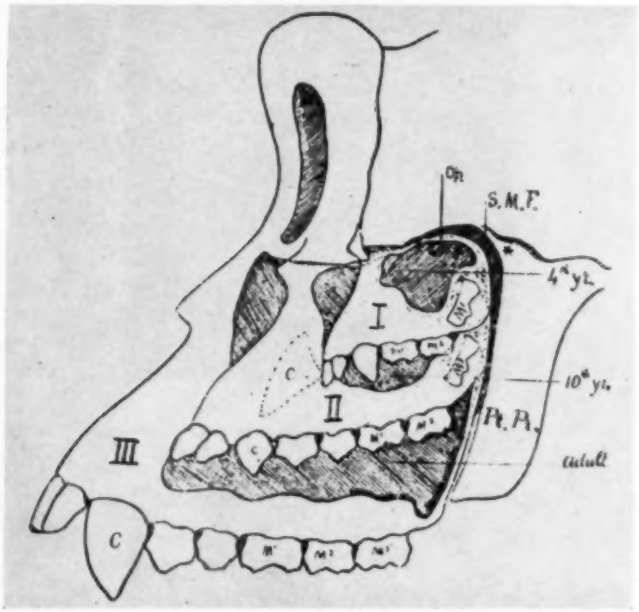

Fig. 6.—"Showing the growth of the maxillary sinus in the orang. Three stages are shown. *I*, At the end of the milk dentition and before the eruption of the first permanent molar (fourth year). *II*, In the middle of the eruption of the permanent teeth (tenth year). *III*, In the adult male. *Op*, Opening of sinus, seen under orbital plate. *S.M.F.*, Sphenomaxillary fossa. *Pt. Pr.*, External pterygoid process. *A point at the junction of the pterygoid process and great wing which may be regarded as the fixed point in the growth movements of the upper jaw. (One-half natural size." After Keith.)

EXPERIMENT ON OMNIVOROUS ANIMAL TO TEST KEITH'S THEORY

The theory of Professor Keith is so in accord with the results of my already described investigations that the next experiment, undertaken to test the truth of his reasoning, was entered upon with reasonable assurance.

My procedure was to study the growth influence of the eruptive forces of only the three permanent maxillary molars on the bones of the face. This was done by removing by aspiration the formative organs of these teeth on one side from a young omnivorous animal before they had exerted their growth influence upon the skull. If Keith's theory was correct, there would be a bony arrest on

the side from which these organs were removed and in the planes through which these teeth would travel in reaching the line of occlusion—downward and forward.

To make the test of value it was necessary to select an animal whose teeth resembled man's in the following fundamentals: First, that it had three permanent maxillary and mandibular molars on a side; second, during the formative process, the crowns of these teeth to be studied faced backward as well as downward, and furthermore were situated one above the other together forming an upward curve; third, when the teeth descended to the line of occlusion, they would travel in arcs of circles both downward and forward; and fourth, that the relation between the descending teeth to the pterygoid plate of the sphenoid bone was similar to that of the anthropoid, including the human, in that it served as a fulcrum for these teeth to act against.

The domestic pig appeared to be the available animal which best fulfilled these conditions. Furthermore, the dentition of the pig is like the human's in that both are adapted to an omnivorous diet. The animal selected for the preliminary experiment was a boar at the time of weaning. At this age (seven weeks) the four temporary molars, normal for this animal, were in place and ready to function, but none of the permanent molars had appeared. A dissection of the head of a litter mate revealed that the first and second permanent maxillary molars were in their respective crypts and in a developmental stage. As yet only the crowns of both molars were developing. That of the first, though formed, was still in a soft, uncalcified state, while that of the second, as might be expected, was just beginning to form. Thus far there was no sign of the third permanent molar.

A curved trocar was introduced through the paper-thin bone covering the right developing first molar. It was then slid distally over the crown thence upward and backward into the formative organ which was aspirated with that of the second molar. As all further development of the calcified portions of these teeth was arrested, these formed parts were, therefore, rendered passive and so were allowed to remain. Thus the only bone destroyed during the experiment was for the small opening to permit the introduction of the aspirating needle. Inasmuch as all of the embryonal tissue within the tooth crypts was removed, the "organizing" cells in the second molar crypt which would normally lead to the development of the third molar were removed with it; this tooth, therefore, never formed. Thus the growth influence of the entire right permanent maxillary molar series was experimentally stopped, while on the other side the normal developmental influence of the corresponding teeth was unimpaired. The result of this unilateral condition at the termination of the experiment nine months later, the animal being approximately 10 months and 3 weeks old, is shown in illustrations 7 and 8, and 10 and 15.*

*The reason for ending the experiment before the animal became full grown, which occurs in the eighteenth or twentieth month, was that the animal showed marked symptoms of muscular paralysis of the hind quarters. Undoubtedly, had the experiment been continued to maturity when all three molars would have completely erupted, and exerted their full influence, the deformity would have been greater. As far as could be determined, the paralysis in no way affected the experiment, for the animal was pronounced of normal size and weight for its age.

It should be here added that similar muscular paralysis frequently occurred during the cat experiments. Should such symptoms show themselves in the group of pigs now being worked on, it would seem, since there was no muscular injury, as though the crypts of the forming teeth served as a storehouse for some very vital but unknown substances.

The deformity was extraordinary. This unilateral growth force had caused practically every bone of the face and cranium to be distorted in all three growth planes. Even the mandible, which in no way entered into the experiment, was also markedly deformed.

Because the experiment was performed on only one pig, it must be and is now being repeated. The result, nevertheless, is so in keeping with what has been described for other animals as to be thought worthy of reporting.

(a) Result in Horizontal Plane.—A study of Fig. 7, which is of the lower aspect of the skull, shows that the power of the slow forward and downward moving molar teeth on the normal side, the left (right in photograph), not only carried the facial bones toward the right, the worked-on side, but the *reaction* of this same unbalanced power on the cranial bones caused a compensating deformity of these structures in the opposite direction. This resulted in a buckling of the skull at the suture junctions of these two groups of bones to such an extent that the zygomatic arch, the connecting girder between the facial and cranial portions of the skull, was shortened to an extraordinary degree. It is apparent, therefore, that as the skull buckled, not only did the face bones move backward but the cranial bones came forward. Or to be more explicit, there was a monolateral arrest in growth of the entire structure, the face bones on the experimented-on side failed to grow forward, while those of the cranium failed to grow backward.* This dual skull change even imprinted itself upon the unexperimented-on mandible as shown in Fig. 15 and explained on pages 502 to 505. Suffice it here to emphasize that not only does the correlated deformity of this bone register the unilateral growth arrest of the facial structures, but the striking asymmetry of the condyles, with their supporting rami, is an accurate index of the induced deformity of the closely associated cranial floor as well.

The unilateral shortening of the facial bones gives experimental evidence to support Keith's theory. The unexpected reactionary deformity of the cranial bones, however, extends his original theory to include these structures, for by deduction one cannot but conclude, if of course this experimental evidence is accurate, that as the skull grows normally in the anteroposterior direction, the entire cranium moves *back* as the facial mass moves *forward.*

Viewing the skull in the same vertical plane, but from above (Fig. 8) one may note that the arrest in growth of both the facial bones and the reactionary distortion of the cranium resulting from the removal of the "vital wedge," which these teeth actually are, extends up throughout the entire skull.

(b) Some Details Regarding Growth of Face and Cranium.—A broadened concept of what took place can be gained by visualizing the great growth which normally must occur at the junction of the face and cranial bones to allow for the three massive molars to take their proper place. This can best be done by imagining the complete dentition superimposed upon the skull of the young

*The skull was photographed resting on the occiput and so placed as to be as parallel with the base line as was possible with such a distorted structure. The occipital bone, the part of the cranium farthest away from the seat of the experiment, was the part least affected and was, therefore, taken as a basis for comparison of the variations of the other bones. It must be appreciated, nevertheless, that since every major bone on both sides of the skull, including those of the cranium even to the occiput, had been so varied the photograph does not represent the exact conditions. What probably occurred was that the entire cranium was carried around to the right so that the cranial bones on the experimented-on side came forward *more* and facial bones moved backward *less* than the illustration indicates.

animal at the beginning of the experiment. As these changed relations are difficult to keep in mind, Fig. 9 is introduced here, showing these three permanent teeth of an adult pig's skull, photographed to scale with that of the young skull and placed in position. It will be observed that the last molar falls surprisingly far back on the cranial base of the immature structure. It is evident that for these three huge permanent teeth to be in correct relation to the skull as a whole, an immense change must occur. Indeed, it would seem that for this to be brought about, the face and cranium must be thrust asunder by some vital process. If our reasoning is correct, each one of the three molars as they successively wheel through their curves of growth in reaching the occlusal line, has much to do with causing these two groups of bones to be swung apart on their axis.

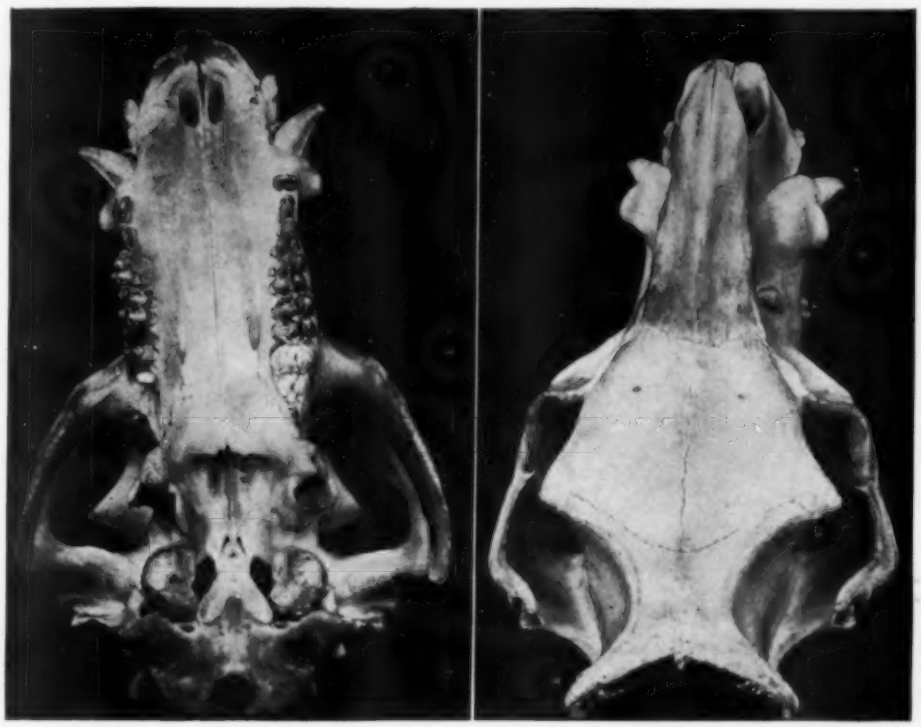

Fig. 7. Fig. 8.

Fig. 7.—Skull of 10¾-month-old pig from which, when the animal was young, the formative organs of the three right maxillary molars (left in photograph) were removed before these teeth exerted their bone growth influence. Observe that the resulting overthrow of the growth equilibrium deformed the entire skull. The unilateral growth arrest of the face and cranium was so great as to cause a skull buckling at the junction of these two groups of bones. Note that the zygomatic process which unites the face and cranium is markedly shorter than on the side where the growth influence of the corresponding teeth was unimpaired.

Fig. 8.—(Upper aspect) shows that this deforming influence exerted up through the entire skull.

It should be noted, as may be observed in viewing the lateral aspect of the unoperated-on side of our specimen (Fig. 12), that these massive teeth undoubtedly do exert a great growth influence particularly during the later stages of eruption. It will be seen that the anterior cusp of the second molar (*a*), which is about to take its place in the dental arch has engaged itself above the distal cusp of the recently erupted first molar. With this arrangement the incline plane relations are such that this moving second molar acts as a wedge on the

first, prying it both forward and downward, and influencing, of course at the same time, the supporting face bone to grow in these two directions. The reaction of this force against the closely associated pterygoid process of the sphenoid bone influences the cranial bones to move in the opposite directions.

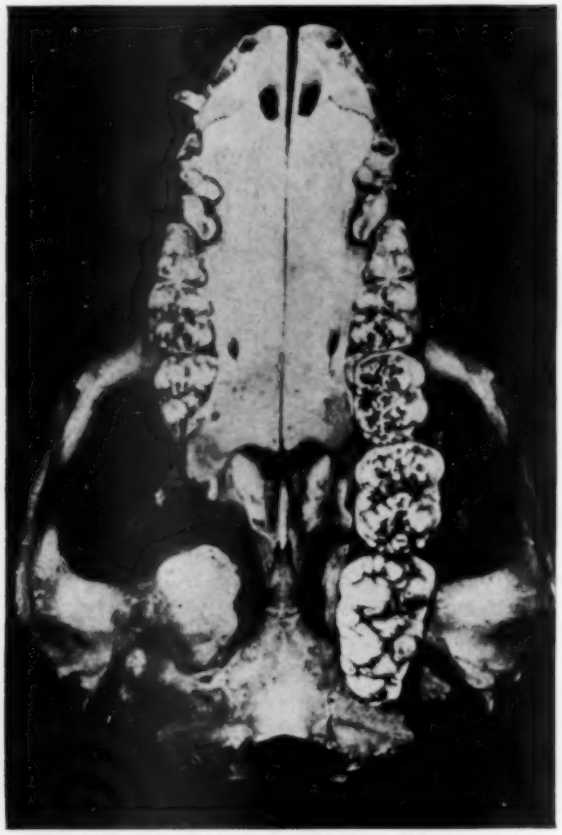

Fig. 9.—Photograph of normal skull of young pig to which, on one side, the three permanent molars, photographed to same scale, have been added behind the last temporary molar. Noting that the third molar falls surprisingly far back on the cranial base, the great growth necessary before these huge permanent teeth take their normal place in the dental arch may be appreciated.

The same wedging mechanism occurred when the first molar came to place. The crown of this tooth engaged itself in a similar manner under the distal cusp of the last temporary molar, carrying this tooth with the supporting bone forward and downward and reacting against the cranial base, as did the molar before it. Precisely the same wedging process will be repeated when the third molar comes to place. The face and cranium are, therefore, caused to be separated one from the other by an elaborate interdental wedging system. The power, therefore, which drives each "wedge" is the very force we are investigating. And so these erupting teeth play a role in making their own space. For results of the downward growth influence of these descending molars in the vertical direction, see Figs. 10 and 11, which show the deformity in this plane caused by the removal of this growth influence. These details are here introduced not because they appear to have been previously unrecorded but because the principles upon which they are based have direct bearing on what

occurs in the anthropoid group up through to man. The following facts concerning the sutures are also necessary to have in mind as they throw light on the experiment now under discussion.

(c) Suture Phenomenon.—There is a closely associated phenomenon regarding the union of the face and cranium which goes to support this wedge theory. It concerns the junction of the two groups of bones at their base and sides, as well as the union of the bones of the cranial floor.

These three groups of sutures in the skull of the immature pig, like the principal sutures of the skull as a whole, are open, but unlike those of the upper face and vertex, which soon close, the three mentioned suture groups remain open much longer, the principal ones remaining patent until the last molar comes to place. (Zuckerman observed the same conditions in the baboon skulls[13] and reference is made to it in the human in Quain's *Anatomy.*[14]) Thus these less firmly united lower skull bones, where the wedging influence of the descending molars is the greatest, are swung apart, as it were, on their axes, by the power stored within the formative organs of these massive teeth. As already pointed out, these molars aid in making the space they must occupy. It should be emphasized again that the conditions apply to the anthropoid group including, of course, man.

There is one suture, the zygomatic, which joins the two parts of the connecting bone-bar between the face and cranium which is so in accord with the axis-swinging phenomenon, as to deserve special emphasis. In again referring to the lateral aspect of the specimen, it will be observed that this suture is a modified "lap-joint" so ingeniously curved anteroposteriorly as to allow for this axial swing. Furthermore, the joint is so constructed in the vertical plane as to permit the entire face mass to move downward and the cranial floor to move in the opposite direction.

The student of suture growth will undoubtedly be struck with the fact that the various visible bony unions on the side where the growth was experimentally retarded (Fig. 13) were more open than on the normal side (Fig. 12). Indeed, the zygomatic suture is so unoccluded as to allow for the passage of a bristle through it. The reason why this and the other sutures on the experimented-on side failed to fuse was not because the growth potentialities here were absent, but because the growth stimulus elsewhere was wanting, i.e., within the formative organs of the experimented-on teeth.*

(d) Results in Vertical Plane.—Returning to the results of the experiment, it will be noted that the deforming influence of the skull caused by the arrest of these downward and forward traveling molars did not end with the horizontal growth direction but extended to the vertical plane. This vertical distortion of the structure is shown in Figs. 10 and 11. It is seen in Fig. 10, which is of the anterior aspect of the skull, that all the facial bones are extraordinarily

*This open suture condition is brought about not only by such experiments as mine where the tooth germs were removed but by other experiments on growth retardation such as vitamin deficiency in monkeys as shown by the work of Dr. Percy R. Howe.[15] (For a digest of Howe's work, see *The Aetiology of Irregularity and Malocclusion of the Teeth*, Brash, p. 144, Fig. 122).[16] Since Howe's vitamin deficiency experiments retarded the growth of the entire skeleton, all the sutures of the skull were open, while in my experiments, which were of a local nature, the lack of suture growth was unilateral, i.e., only on the worked-on side of the skull.

twisted. Indeed, this twisting of the premaxillary and maxillary bones, the teeth-bearing structures, is so great that on the animal's right, the interfered-with side, the teeth have failed to descend to a marked degree to the same plane of those on the normal side. The closely associated nasal cavity is also correspondingly asymmetric throughout its entire length from the anterior openings back to the posterior nares. Even the muzzle of the animal also shared in this deformity, it being appreciably twisted toward the right with the facial bones and there being an asymmetry of the nostril openings, with the right appreciably smaller than the one on the normal side. It is remarkable that even these soft parts so remote from the seat of the experiments should be so deformed.

Fig. 11, which presents the posterior aspect of the skull, shows that there is a vertical asymmetry of the cranial bones here as well. The pterygoid plate of the sphenoid bone on the side which normally would have served for the fulcrum against which the molars would act has failed to grow downward, as did the corresponding plate on the left where these teeth were present. This variation is indicated by the drawn line, *a*.

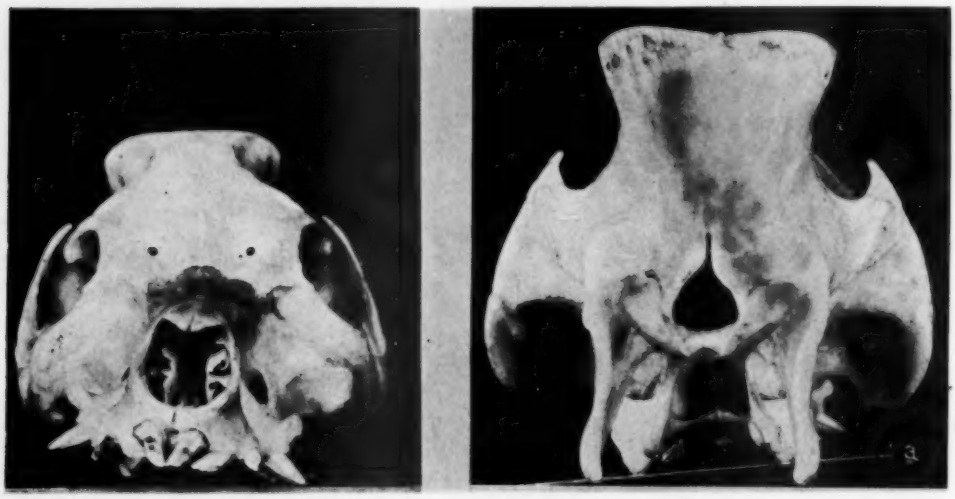

Fig. 10. Fig. 11.

Figs. 10 and 11.—The experimented-on pig's skull viewed in vertical plane. Observe how the unilateral removal of the growth influence of the three permanent molars twisted the skull. Note particularly in the anterior view the lack of growth of the face bones on the side from which this growth influence was removed.

Observe in Fig. 11, shown by line *a*, how the pterygoid plate of the sphenoid bone, against which these molars would normally act, has failed to grow downward as did the corresponding process on the normal side.

It is also seen that the corresponding mandibular fossae with which the condyles of the mandible articulate are far from being on the same plane. This brought about a correlated asymmetry of the condyles themselves as the photographs of the bone show (Figs. 14 and 15).

(e) Correlated Effect on Mandible.—Undoubtedly, the most striking feature of the experiment is the manner in which the monolateral removal of these three tooth germs has affected the shape of the mandible. It is of interest to note, as shown in Figs. 14 and 15, how this bone adapted itself to the changed conditions. As the bone was in no way experimented upon, the deformity is a deformity of correlated growth. This bone, therefore, may be regarded as an index of what occurred in the skull proper.

To account for this deformity, which in reality is a dual one, it must be understood that the mandible, though not united to the skull by sutures, is closely associated with both major parts of the structure. The body of the bone is associated with the facial portion through the medium of the occlusion of the teeth, while the parts posterior to the body, the two ascending rami and their condyles, are associated with the cranium through the medium of the articulation of the mandibular condyles.

Fig. 12.

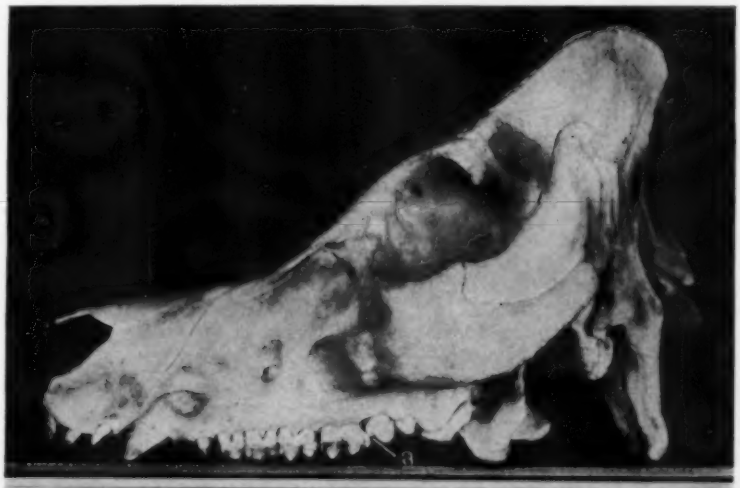

Fig. 13.

Fig. 12.—Normal side of skull, viewed laterally. Observe that the anterior cusp of erupting second molar, *a*, has engaged itself above the distal cusp of the first molar. With this condition, the resultant power which drives this erupting molar down wedges the tooth against which it acts with the supporting bone in two directions—downward and forward. At the same time the reactions of this force against cranial bones influence the structure to grow in the opposite direction.

Fig. 13.—Experimented-on side of skull. Observe the open sutures, particularly the zygomatic. These sutures failed to occlude owing to the fact that the growth stimulus was elsewhere experimentally removed.

It is evident that had both parts of the skull grown normally, there would have been bilateral symmetry throughout—but this was not the case. There was a double unilateral asymmetry of the structure as a whole. The lack of growth in the facial bones recorded itself by a monolateral shortening of the mandibular body. The arrest in cranial growth recorded itself in the unilateral lack of growth posterior to the body of the bone. The reaction of this dual skull change,

therefore, duplicated itself in this mandible, which in itself is a remarkably deformed structure. But, more than this, there is imprinted upon it a complete record of the induced deformity of the major bones of the face and cranium.

Two other facts may be learned from the way this skull deformity repeated itself upon this unworked-on mandible. First, it gives experimental evidence that normally the growth of the skull base and mandible are bound together in an intimate developmental complex as stressed in Keith's earlier writings,[17] and recently by Aleš Hrdlička.[18] Second, it reveals the magnitude of the forces we are studying. When it is realized that this unworked-on massive bone was putting forth its best efforts to grow normally, and, at the same time, to stabilize the normal growth of the deformed skull—both of which it failed to do—one may more fully appreciate the magnitude of the experimented-with power within the formative organs of those three teeth.

Fig. 14.

Fig. 15.

Figs. 14 and 15.—Mandible of the experimented-on skull. As the growth of the bone was not interfered with, the deformity is a deformity of correlated growth. This bone, therefore, is an index of what occurred in the skull proper. The overthrow of the growth equilibrium of this massive bone which was putting forth its best efforts to grow normally and at the same time to normalize the skull growth as a whole—both of which it failed to do—the magnitude of the power within the formative organs of the developing molars can be better understood.

FORMING TEETH REGARDED AS HIGHLY SPECIALIZED EPIPHYSIS

It must be admitted that little is known about the force whose results we are studying in three groups of animals. In certain respects, however, it resembles the forces associated with epiphyseal growth. Both have, at least, certain fundamental conditions in common, among which is that each acts against pressure. The epiphyseal growth, particularly in the growing leg bones, acts against gravity pressure—the body weight, while the developing teeth, as shown by these experiments, act against the pressure of the growing skull bones. Aside from this, the growing teeth and the growing epiphysis have many morphologic

similarities in common. Both are confined within bony walls, each is extremely vascular and both grow very rapidly. Another similarity is that both are supplied with preosseous fluid, and each contains a large amount of embryonal tissue—those immature connective tissue cells always associated with calcification. With these facts in mind, it must be understood that we regard the forming teeth in animals and the human, both temporary and permanent, as highly specialized epiphysis.

Be this as it may, the accelerated growth of the facial part of the skull during childhood and adolescence, as pointed out in the introductory remarks, can only be accounted for by the fact that the face bones, particularly the teeth-containing bones, possess during their period of rapid enlargement, and only then, a growth mechanism peculiar to this stage of development, for no such mechanism exists at any other time or in any other part of the skull.

In these experiments, this specialized growth acceleration was traced to its source—the growth energy stored within the formative organs of the teeth. My study of this power, in isolation from the other factors common to all growing bone, disclosed that each forming tooth was a growth center. These centers of growth acceleration, regarded collectively, serve as a potential growth reservoir, the power from which is released to the bone, as each one of the developing dental units journeys from its crypt, deep within the foundation structures of the face, to its final place in the dental arch.

SUMMARY

In comparing the results of these experiments on the rodent, the carnivora, and the omnivorous animals, one is struck with the fact that there is one common factor which applies to all these induced deformations. It is that there is an arrest in the growth of the facial bones on the side and in the direction in which the experimented-on teeth would normally grow. In the rat, the persistently growing incisor grows in the forward direction, and the resulting deformity is in the horizontal plane. In the cat, the permanent maxillary teeth grow in a downward direction and the arrest was in a vertical plane; while in the pig, the growth direction of the experimented-on molars would have been both forward and downward and the arrest in growth was in both the horizontal and vertical plane.

These studies furthermore show that the erupting teeth play an important part in the building of their own scaffold—the bones of the face. It must also be appreciated that the same underlying principles apply to the higher animals including man. Indeed, these experiments point to the fact that the developing dentition, regarded as a unit, is a center of growth of the facial skeleton and influences to no small degree the growth of the base of the cranium.

It is hoped that the student of growth will regard this growth power which we have isolated and studied apart from the other growth influences of enough importance as to open up a new chapter in the study of the mechanism which transforms the face of the child to the adult. Be this as it may, throughout these investigations, though essentially of a biologic nature, a diligent search has nevertheless been going on for the hidden causes of the deformities of these bony structures. It must be realized that any influence which retards

the power we are studying has a deforming influence on the facial skeleton. One, therefore, can more clearly appreciate how the pernicious influence of deficiency diseases, the endocrine disturbances or other serious diseases which attack the child, retard the growth influence of the twenty temporary and thirty-two developing permanent teeth as they journey from their crypts to their normal place in the dental arches. Thus we are continuing our search for the causes of the arrest in the growth of these bony structures with an enlarged vision.

I wish to acknowledge my indebtedness to Dr. Otto Krayer for the courtesies of the pharmacologic laboratory of the Harvard Medical School and for allowing me the services of his skilled technician, Mr. Henry W. George. Thanks is also extended to Dr. Glover M. Allen for his valuable advice and for the opportunity of studying specimens in the Harvard Museum of Comparative Zoology, and to Dr. Earnest A. Hooton for his wise counsel and for allowing me to study the valuable collection of anthropoid skulls in the Peabody Museum. Finally, I am much indebted to Dr. Harold L. Weatherford, Assistant Professor of Anatomy, for his sympathetic interest and suggestions regarding the text.

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230 Beacon Street.

THE EFFECT OF THE SELECTIVE SERVICE ACT ON THE PROFESSION OF ORTHODONTICS

BRIGADIER GENERAL LEIGH C. FAIRBANK, WASHINGTON, D. C.

THERE have been a great many serious problems, with reference to dentistry and national defense, which have engaged us in Washington. Few people understand what it is all about; many hold me personally responsible for dentists being drafted in the operation of the Selective Service Law. I have no more to do with selective service and the operation of that law than I do with the running of the police department of New York City. It is an entirely separate governmental agency, responsible solely to the President.

We have taken a deep interest in the welfare of our profession. Purely in an advisory capacity, to aid the Dental Advisory Committee appointed to assist Selective Service, the Dental Division, Surgeon General's Office, acts as liaison between the War Department and Selective Service insofar as it involves regulations governing the dental problems of men inducted into the Army, but that is all.

Looking into this problem of national defense and the obligation of every American citizen, there suddenly dawns upon everyone, including orthodontists, the fact that we as American citizens owe something to this country. However, one cannot help but feel that as a specialized group in our profession of dentistry, as a health service, perhaps we in the American Association of Orthodontists have for many years been assuming that one of the largest and most beautiful aspects of health service is our service to children. I have gotten a thrill out of that, as many of you have, although I have practiced orthodontics a much shorter time than a great many of you. One feels that he has rendered a service to our people, and that perhaps he has contributed in a very, very definite way to the welfare of our nation as a whole. Unquestionably it is so.

However, looking at this larger consideration of dentistry and dental health as an important aspect of our national welfare which goes beyond the bounds of national defense, there comes a feeling that a special consideration must be given to the orthodontic specialty. Here is the reason: Early in this year a young orthodontist from the East had an appointment with me, and came to my office to tell me his story. Some few get in—I presume it was because he was an orthodontist! This lad was of draft age. He had been in the practice of orthodontics some four years having at that time a large number of contracts for the treatment of children. He also had a low draft number and was about to be called. He was inducted. At present he is serving in the army as a private on a nonprofessional status. He is rendering no particular service and the army benefits in no way through his professional training. There were no means at that time which would defer dentists, or orthodontists, or the medical practitioners and specialists.

Presented before the Fortieth Anniversary Meeting of the American Association of Orthodontists, May, 1941, New York, N. Y.

At this time there are over one hundred dentists serving as privates. They would not make up one-half of an infantry company, and when you come to deal with military service in terms of millions you can see the tremendous loss that represents. As a matter of fact, one hundred dentists inducted as just plain soldiers represent the dental service available in this country for 180,000 people.

This has all been taken up, and I am glad to report that progress is being made to solve this problem, particularly as it relates to orthodontics and how each one of us is affected. It assumed a very serious aspect when some of the leading men of the profession called my attention to the situation that existed in their own offices, men who had been in the practice of orthodontics for thirty and forty years. They are actively engaged in the practice of orthodontics today, but the big load is taken by their young associates, who in many instances are subject to the draft. This law is the most perfect expression of a democracy in these terrible days, and certainly we in orthodontics, as well as in all health services, should take the attitude that as American citizens we want to support our country without trying to dodge an important obligation and an issue which is growing in this country.

Suppose these young men of draft age are taken out of the orthodontic practices and the big load has to fall on the shoulders of these patriarchs of ours. It would be a most unhappy situation. They would willingly do it, but I don't believe they should.

There was one way to get this picture adequately together so that it might make an impression in Washington—that was to have a survey made of the work being done by our orthodontists in this country. Questionnaires frequently raise considerable doubt and concern in the minds of some people. They think some facts are no one's business but their own, but I think this is a time when we should trust our colleagues and confreres. There may be some doubt whether you should trust me. You have a right to your own opinion. I have come to develop some doubts myself about the dental profession, because the dental profession does not understand our situation in the War Department.

The point is, if we can get sufficient information as to the number of children in this country who are under orthodontic treatment at the present time, if we can build up statistics from the information we desire on that questionnaire, it will be possible, I am confident, to leave the orthodontic profession intact and not create the unhappy situation that occurred in the instance of that young man who called on me, or the very great problem of those who have associates with them who might be called into service and be absolutely wasted from a professional standpoint.

The Children's Bureau is deeply interested in what is being done for children. Of all this splendid work, we think the service the orthodontists are rendering is just as magnificent as that of the orthopedists and our marvelous men working with those afflicted with infantile paralysis.

It was my great hope that we could have enough information to give us a fair estimate of all the children who are under the care of recognized orthodontists in this country so that we could have an adequate statement of the number of the young men in orthodontics. I mean qualified young men, not the make-believes. We could make an accurate summation of these reports and

present the information to the Children's Bureau. In doing that it would be possible for such a report to reach higher governmental officials in Washington, which would safeguard our orthodontic profession.

Just to show you how serious this can be, the young man who called on me had quite a group of children under his care. He had no one to whom he could turn to care for them. What becomes of those children? A great many of those in so-called retention, without supervision and the watchful eye of an orthodontist, will relapse. Those who were under active treatment and receive no attention—we all know what will happen to those cases. In any event, the sad part of it is that this young man will be ruined in the community when he returns; those people with whom he had contracts are going to expect something of him if he goes back. For years he will be trying to correct the things that happened during his absence, over which he had no control whatsoever. But over and beyond that is the sad picture of what failure means to the orthodontic profession. Orthodontics will have a black eye in the community.

I flew up to New York on several occasions and had conferences with the most cooperative group, to whom I want to pay my very, very profoundest respects, and we spent evenings together trying to work out this problem of the questionnaire. I had hoped that, for your sake, we might have a very active and ready response from the orthodontic profession so that we might have information to present to the authorities in Washington. We want orthodontics to prevail. We want this great good extended. We want those devotees of our profession, who have given so much, still to continue. We want the young men to be encouraged. We want to contribute to the welfare of the youth of this country. We want the doors open for them in the uncertain years that lie ahead. Your cooperation and your assistance in this matter with the American Association will do much to place in my hands information which I can use to help you, and without which I can do nothing.

INSPECTION OF A SURGICAL-ORTHODONTIC CORRECTION FIFTEEN YEARS AFTER TREATMENT

Case Report

R. C. Willett, D.M.D., Sc.D., F.A.C.D., Peoria, Ill.

AT THE time of the First International Orthodontic Congress held in New York City, Aug. 16 to 20, 1926, I reported my experience in the surgical-orthodontic correction of a macro-mandibular deformity that had been under treatment during the previous year. Since that report was given fifteen years ago, many inquiries have been made concerning the outcome of the case.

The patient, Miss C., was 19 years of age when the major operation was done. Following the corrective treatment, her general health improved, and five years later she was married. Twins, a boy and a girl, were born Aug. 25, 1933. These children were normal, and now at the approach of their ninth year, the transition from deciduous to permanent dentition is progressing normally.

Fig. 1.

Fig. 1, a comparison of the radiograms taken May, 1926, and Jan. 25, 1941, shows that there has been no material change in occlusion. There appears to

Presented at the Fortieth Anniversary Meeting of the American Association of Orthodontists, May 5 to 8, 1941, New York City.

have been no particular change in the bone structures where the mandible was resected (Fig. 2).

Fig. 2.

A detailed report of the surgical and orthodontic technique applied in the correction of this case may be found in the October, 1926, issue of the *International Journal of Orthodontia, Oral Surgery and Radiography*, and in the published proceedings of the First International Orthodontic Congress.

535 Jefferson Building

REPORT OF THE AMERICAN BOARD OF ORTHODONTICS

The Members of The American Board of Orthodontics beg to submit herewith their customary Annual Report:

Some time having elapsed since the preparation of the last booklet containing information concerning the Board and its activities, it was decided to get out a new one much more comprehensive in its scope and based upon the wider experience of the Board gained through the large amount of correspondence with those seeking certification. While this result may not fully satisfy the demands of such a booklet, the Board feels, nevertheless, that it does supply more ample and accurate information, first for the dental profession generally, then for the orthodontic specialty, and finally for those of its members who may desire to make application to the Board. These booklets have never been distributed indiscriminately, but they are available to anyone who seriously considers making application for certification. In our last year's report, reference was made to a second article which was being prepared on the American Board of Orthodontics to be published in the *American Dental Association Journal* similar to the first which was published in the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY. This second article was completed and through the cordial cooperation of the editor of the *J. A. D. A.* early publication and favorable space was given to it. The object was to familiarize the general practitioner with the history, aims, and operation of the Board since its inception.

For several years the Board has felt that the orthodontic specialty as well as the dental profession generally should evolve a more orderly, comprehensive, and uniform nomenclature; one that would be truly descriptive of the anomalies referred to in the text of any writer on these subjects. Acting upon this conviction, a good deal of time was given at the last meeting to the discussion of this matter, and it was finally decided to appoint Dr. James D. McCoy, who had given considerable thought to this problem and in addition was already a member of the committee on nomenclature of the A.A.O., a committee of one to make a study of the subject and report back to the Board at this meeting. Dr. McCoy has done this in his usual thorough manner, offering as his report a paper he prepared for this purpose and read as essayist before the Southwestern Society of Orthodontists. The advantage of this manner of making his report is that as soon as the paper is published it becomes immediately available to all students and members of similar committees of the various dental and orthodontic societies, and the Board devoutly hopes that they will also offer concrete suggestions in the near future so that a committee representing all organizations with a definite interest in this important matter might prepare a report to be submitted at the American Association of Orthodontists meeting a year from now to the end that a truly scientific terminology might be evolved and adopted which if not perfect might at least start us on the way toward the eradication of the serious confusion that now exists. The American Board of Orthodontics wrestles with this confusion as no other organization or body is called on to do since its members each year are called upon to give careful and sincere consideration to a large number of theses. The difficulty of arriving at a true evaluation of the material presented in these papers or of making an intelligent comparison of their merits would be greatly lessened by the adoption of an accurate and uniform terminology. At the meeting of the Board just concluded a preliminary list of words and terms was approved as acceptable to the Board. Other words and terms may be added in the future. In connection with this subject permit me to call your attention to the report of the nomenclature committee of the A.A.O. recently published in the proceedings of its last meeting. It has an encouraging tone.

The President of the American Association of Orthodontists, Dr. Henry U. Barber, who is also chairman of the Ketcham Award Committee, has informed us that the 1941 recipient of this honor will be Dr. Frederick Bogue Noyes of Chicago. If a lifetime devoted to the advancement of the ideals of his calling entitles a person to exceptional recognition, then no more deserving selection could have been made, and the Board takes pleasure in offering its congratulations to Dr. Noyes.

In our last year's report we spoke of the formation of other specialty boards and of an Advisory Board which was being organized along lines similar to the Medical Advisory Board. This Board has actually been organized but is composed of representatives from many different organizations and societies so that it is not exactly analogous to the Medical Advisory Board. In time it may prove useful, especially if reorganized to comprise in its membership only representatives of the various specialty certifying boards.

The American Board this year has been able to prepare and put on an exhibit for this meeting composed of material presented by applicants for certification. This was well received two years ago and we hope has been of interest and value to the members during this meeting.

There has been no cessation in the activities of the Board during the past year. If anything the work has been a little heavier. The character of the presentations made by applicants shows a steady improvement probably due to the fact that many of them have been preparing for several years for this event, and it might be suggested that in this way the Board exerts a stimulating influence on those members of the profession who desire to achieve the highest standard of service to their patients. There have been issued up to the present time *197* certificates and there are now before the Board *46* applications. The sincerity of the applicants and their desire to make creditable presentations seems to indicate that their certification is regarded only as a step in their careers which they will later continue to develop to the credit of the Board, of the profession generally, and of themselves, to the end that better service may be given to their patients.

We again wish to express our appreciation for the splendid support and cooperation accorded the Board by the officers and members of the American Association of Orthodontists, and, I might add, by the dental profession generally.

H. E. Kelsey, President
833 Park Avenue
Baltimore, Md.

REPORT OF PUBLIC RELATIONS COMMITTEE

The Public Relations Committee and the New York City Sub-Committee, with the latter serving as a Board of Directors for the Public Relations Bureau, have had another active year.

The duties of these committees are very broad in their scope and provide for: (a) recommendations for lay and general orthodontic education; (b) study of economic conditions and making such recommendations as seem wise and expedient; (c) keeping the association informed as to the character of legislation introduced in various state and national legislative bodies affecting the practice of orthodontics or the dental welfare of the public; (d) use of all proper influence to secure the passage of such laws as are beneficial and the defeat of those that are detrimental; (e) cooperation with like committees of similar organizations and with local, state, and national dental societies in legislative matters of mutual interest; (f) the privilege of appointing subcommittees to perform certain duties subject to the approval of the Board of Directors.

General Education.—The lay and professional educational program developed last year was found so satisfactory and far-reaching in its effect that it was expanded and continued during the past year. Even though our efforts have been more or less exploratory in character, the committee has been agreeably surprised in the way its material has been received by the members of the different health organizations. The reaction of those receiving the educational material has been more than a passive interest. The numerous inquiries and orders indicate a real eagerness on the part of these lay and professional health organizations for orthodontic information. The public interest has been found to be keen enough to indicate a popular magazine on dental health patterned after that of *Hygeia,* published by the American Medical Association, would meet public favor.

Publicity.—A watchful policy has been maintained on objectionable and detrimental methods of publicizing orthodontics. The management of all dental journals, both proprietary and nonproprietary, with one exception *(Dental Items of Interest),* has given all mail order diagnostic and treatment laboratory advertisements a nonacceptable rating.

Several complaints were registered against misleading articles and advertisements on orthodontic subjects the past year. Nearly all of these incidents were found to be more accidental than deliberate in their implications. Friendly criticism and constructive suggestions for correction have led to satisfactory adjustments.

State Legislation.—The Dental Act of Michigan underwent extensive revision in 1939, and among other things, set up strict prohibitions against advertising. It further provided a licensing system for specialists patterned after the Oklahoma Dental Act. Some phases of the Act were contested and submitted to a vote of the electorate in the general election of November, 1940. It was held valid by popular consent of the people. The campaign issue was advertising restrictions and not the establishment of a system of licensure for the specialties.

Certification.—Further progress is being made toward certification and licensing of the specialist. The American Society of Periodontology have announced the formation of board with tentative plans after 1945, calling for a graduate course in appropriate subjects leading to a Master's Degree or its equivalent as part of their preparation for examination.

The American Society of Dentistry for Children has authorized the selection of a temporary board to draw up suitable plans for certification in dentistry for children in accordance with the plans and objectives of the Advisory Board for Specialists. This board is to report at its 1941 annual meeting.

The American Society of Oral Surgeons and Exodontists has appointed a committee with instructions leading to the establishment of a certification system.

The Advisory Board for Dental Specialties organized about three years ago to assist in the coordination of education, certification, and licensure on an approved professional basis is continuing to function under handicap. It failed to win the active cooperation of the

American Dental Association due to its having set up and assigned the Council on Dental Education this responsibility. Reports emanating from members of the Council on Dental Education indicate that this body will not be able to accomplish much in this field within the very near future on account of more urgent business.

The National Association of Dental Examiners has declined active participation for the time being. In their estimation the work of the Advisory Board has scarcely reached a stage where it relates properly and immediately to the scope of this organization.

These trends in professional thought and action should do much toward developing better educational standards in preparation for practice of the specialties. It is further logical to assume that these forces will lead to a better appreciation and understanding of regulatory legislation.

All dental organizations look with favor on certification but some appear to be skeptical about their ability to bring order out of chaos. It may be pointed out that certification systems are much easier to establish and are more amenable to change since they are established and operated by distinctive organized groups of specialists. While certification systems are highly constructive and desirable, their sponsors should not discourage the enactment of suitable legislation by the states. The comparative value of the two systems cannot be fully discussed in this report. The principal object of both systems is the establishment and maintenance of a practical regulatory system capable of producing specialists in adequate number with reasonable degrees of proficiency.

Experience and careful study of the two plans justify making the assertion that the legalized system, if based upon proper requisites and inforcement procedures, is by far the best method of supplying an adequate number of specialists with a fair degree of competency for public service.

The principal difference in these two systems lies in the fact that one is optional and the other compulsory. It is obvious that a legalized system with equal standards is more effective in gaining recognition and respect than a noncompulsory one. The legalized system for regulation of the specialties in Illinois, Tennessee, Oklahoma, and Michigan has on the whole proved satisfactory and on its record justly merits the consideration of other states.

Our Association was represented at the Congress of Dental Education and Licensure sponsored by the Dental Council on Education which was held in Chicago on February 15, 1941, by Drs. L. B. Highley, Geo. Moore, and L. M. Waugh. The problems presented for discussion were mostly confined to those of undergraduate standards. Some of the speakers did, however, introduce the subject of education and licensure for the specialties. This apparently was inspired by information furnished by our Public Relations Bureau. Dr. Norton H. Jones, a member of the Ohio Board of Dental Examiners, in particular, discussed the merits of licensure for the specialties. Our representatives were so inspired by the proceedings that they decided to call a meeting of undergraduate instructors in connection with this convention. The purpose of the conference is to promote better and more uniform educational standards. Another outgrowth is the paper being presented by Dr. L. M. Waugh on "The Outlook of Dental Education and Licensure."

Graduate Education.—Minimum requirements of one scholastic year in dental schools under the jurisdiction of universities are becoming more firmly established each year. The preparatory schools are continuing to fall more and more into disrepute as the result of the general recognition being accorded these higher standards.

During this past year the New York State Board of Dental Examiners petitioned the Board of Regents for the educational institutions of the state to require all postgraduate schools of orthodontics to become affiliated with an approved university.

Federal Legislation.—The Federal Government has again vastly extended its socialistic influence in the field of dentistry during the past year. The Social Security Administration, National Youth Administration, Farmers Security Administration, and Works Progress Administration have all entered the field with extensive programs in remedial and curative dentistry. The dimensions of these dental programs are designed to provide dental care for millions of families at a cost of millions of dollars. They threaten to work an economic

hardship on the dental profession and the federal treasury. These programs are receiving the aid of the National Health Committee of the American Dental Association. According to the ruling of the Crippled Children's Division in the Department of Labor, only the extreme types of dental anomalies among the indigent are classified as justifying financial aid.

The Acting Director of the Crippled Children's Division in the United States Department of Labor, after having just recently received the booklet published by the American Board of Orthodontists, states the information it contained should be of great assistance to his office in advising state agencies regarding desirable qualification standards for the selection of orthodontists to provide services for crippled children under the state programs. This is a positive indication that an extensive program of state orthodontics is in the making. This declaration will justify a further fact-finding investigation by the Public Relations Committee to learn more about the government's intentions, and present their program to this Association.

Only a few grants to states have been allocated for orthodontic services. The justification for any such grants being made for orthodontic treatment appears to be absolutely impractical from a sound socioeconomic point of view. The allowance for fees and methods used for the selection of professional care does not make reliable service possible. Thus, the expenditure of public funds for orthodontic care of the indigent is unjustified. Thousands upon thousands of the government's clients, and especially children, are being rendered free and nearly free dental care. It gives us cause to wonder what the psychologic effect will be upon the recipients and the public in general when it comes to making a fair monetary appraisement of dental services.

Economics.—The cost of producing orthodontic service is at an all-time high. The number seeking orthodontic service is substantially increasing, but the number willing to pay commensurate fees appears to be decreasing. This situation appears to be due to the public's becoming better acquainted with the benefits of orthodontic treatment. At the same time they have conceived the idea through the influence of propaganda in support of socialized medicine and dentistry that dental services are too high. Many show an unwillingness to accord orthodontics a place in the family budget in preference to things of less importance.

Unstable business conditions and their influence on incomes naturally have been a factor in affecting the prospective patient's ability and willingness to purchase orthodontic services. Orthodontic fee scales over the country apparently have been forced down to a place where they are little above the low mark of the depression period.

An optimistic outlook appears to be in the offing as the result of the tremendous boost being given to business by the defense program. Some of the gain naturally expected in this connection will not be reflected in orthodontic practice. Greatly increased taxes will stifle the buying power of the increased incomes. The shifting of millions of men with families into military and industrial lines to meet the emergency will cause many who have been planning treatment to postpone it.

A word of warning may not be amiss. In the event orthodontists should enjoy much larger incomes as the result of a business boom in their communities, the committee cautions against unwarranted expansion in homes and offices, and speculative outside investments. History indicates that such stupendous war and defense measures must of necessity undergo extensive, if not violent, financial readjustments, either during the emergency or after it has ended. Heavy indebtedness without adequate monetary reserves brings financial distress during periods of depression.

Military.—Full cooperation of the bureau was extended at the outset of the Defense Program which went into high gear last summer. It was thought that the facilities of the bureau might be useful in disseminating military information to the membership or gathering information and data of value. Recent developments have led to a survey being made by a special committee of the subcommittee under the direction of President Barber. The object of the survey is to assemble data, which should prove useful as a guide in maintaining an equitable distribution of orthodontists to supply the public need and at the same time provide an adequate supply of specialists in orthodontics to meet the needs of the military

establishment. As this is a highly important matter, we urgently request all members to fill in their questionnaires and mail them without further delay.

Since the art and science of orthodontics is capable of teaming with the oral and plastic surgeon to a great advantage in the field of maxillofacial surgery for the reconstruction of mutilated faces, it would seem fitting that orthodontists should have some special recognition in this field and be provided with some special training before and immediately after induction into military service. We, therefore, propose that a special military committee be appointed to study this problem with the chief of the Army Dental Corps.

The official Public Relations Committee desires to commend the Board of Directors for the Bureau, and the Director, for their faithful work during the past year. We recommend that the Bureau of Public Relations be continued under its present personnel with an appropriation of no less than $2,500 for the next fiscal year.

FINANCIAL STATEMENT FOR FISCAL YEAR
MAY 1, 1940, TO MAY 1, 1941

INCOME:		
A. A. O. appropriation	$2,500.00	
Sale of educational material	530.91	
Total Income		$3,030.91
EXPENSES:		
Office maintenance salaries	$1,550.00	
Printing and misc. expenses	1,240.78	
Total Expenses		$2,790.78
Balance on Hand		240.13

The Report from the Director of the Bureau is appended as a part of the Committee's report.

T. W. SORRELS, Chairman
FRANK NICOLOI
GEORGE A. BARKER

REPORT OF PUBLIC RELATIONS BUREAU, AMERICAN ASSOCIATION OF ORTHODONTISTS
MAY 1, 1940, TO APRIL 1, 1941

April 15, 1941

To: Dr. Tullie W. Sorrels, Chairman
Executive Committee
Oklahoma City, Okla.

From: Dwight Anderson, Director
Public Relations Bureau
292 Madison Avenue
New York, N. Y.

The second year of work of the Public Relations Bureau has been accompanied by increased interest and effort on the part of the committees in charge, as well as the membership of the organization.

Meetings of the Board of Directors have been held with regularity and a nearly perfect record of attendance. The Board has met on the following dates during the fiscal year 1940-41: May 14 at the Chicago national meeting; June 21, Sept. 20, Jan. 7, Feb. 25, March 17, and April 14.

The distribution of educational material was continued during the year, in large part comprising sales at bulk sale rates, with a considerable amount of free mailing to individuals and organizations unable to pay but deemed of sufficient importance to justify the expense.

Facts About Orthodontics for Health Workers.—The sale of this leaflet exceeded in the second year the results obtained during the first year when it was published. Total sales are: 44,552 for both years; in 1939-40, 21,678; in 1940-41, 22,874. One hundred thousand copies

cost us $397.80 showing a current profit of $1.30. Free and promotional distribution amounted in both years to 11,000 copies, leaving on hand for the future, 44,400 copies. It is anticipated that this document will be of use over a period of many years, and the wisdom of the original print order of 100,000 appears to be established.

A request was received from Dr. Roy B. Dean of Mexico City for permission to translate "Facts About Orthodontics for Health Workers" for use in Mexico. This was granted by the committee.

Getting Ready to Tackle Life.—This leaflet, of a more popular nature, was published late in the season, not being offered widely until January, 1941. In three months, however, its sale has far exceeded the sale of "Facts" during the first year. A total of 35,556 copies have been sold with a revenue of $336.45. The cost of 100,000 copies was $558.45. There is little question that the cost will be returned to us in full long before the total supply has been exhausted. We have distributed 1,000 copies free, and have on hand 63,450. Temporary deficit, $222.00.

An interesting development concerning this document occurred when the C. V. Mosby Company ordered 5,000 copies to accompany a circular letter to be sent generally to dentists to increase the circulation of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY.

Free Distribution.—Mailings of "Facts" were made to the following groups during the current year: Tuberculosis Association secretaries; members of the American Public Health Association; members of the American Society of Dentistry for Children; and to the entire list of Diplomates in Pediatrics and Otolaryngology.

Additional to the mailings made to the membership of the society of "Getting Ready to Tackle Life," the leaflet was sent to the members of the American Society of Dentistry for Children. Publicity was obtained in the following journals: *Florida State Dental Society Journal, Texas Dental Journal, Dental Survey, Kansas State Dental Society Journal, Nassau County Dental Society Bulletin,* AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY, *Newark Dental Club Bulletin, Southern Dental Society of the State of New Jersey Bulletin, Essex County Dental Society Bulletin, American Dental Association Journal, Harvard Dental Alumni Bulletin, Journal of the Canadian Dental Association, New York State Dental Journal, Journal of the Second District Dental Society of New York.*

Radio.—Two radio scripts have been prepared by a professional script writer; one of these will be part of the radio program at the 1941 meeting in New York City. The other, a dramatized presentation, awaits further action by the committee.

Motion Pictures.—The possibility of educational motion pictures has been investigated with the result that the cost, plus the problems of maintenance and distribution, indicates that a venture in this direction would be hazardous.

Exhibit.—Investigation of exhibit possibilities disclosed, as to this matter also, complexities of preparation and presentation which appeared to discourage undertaking the project.

Correspondence.—Perhaps the most interesting part of the work of the Bureau has been the running fire of letters and inquiries, showing a rapidly growing interest in our work. Among organizations whose favorable attention has been drawn to our work resulting in correspondence may be mentioned: several dental colleges, Cooperative Extension Work in Agriculture and Home Economics of the State of Illinois, University of Idaho, National Dental Hygiene Association, Bureau of Dental Hygiene of the Iowa State Department of Health, American Society of Dentistry for Children, Mexican and Canadian Orthodontic Societies, Yale University School of Medicine, University of Michigan School of Education, American Red Cross, Social Security Board, and numerous state, county, and city health departments and social agencies throughout the country.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Orthodontic Treatment of Adult Patients: By Kaare Reitan, *Den Norske, Tannlaegeforenings Tidende* **51**: 41-62, February, 1941.

While in the child one may expand the dental arch by using mechanical appliances and in this way stimulate growth and development of the osseous structures of the jaw, a similar rapid growth of the bone does not take place in the adult, because growth and phosphatase activity have entered into a more static period. This may, in a case of expansion, manifest itself as a predominance in bone resorption. The result is more or less a diminishing of the labial or buccal alveolar crest, and a lack of compensatory bone growth.

In the adult, the physiologic wandering of the teeth is mainly limited to a tooth movement in mesial or distal direction. The author is of the opinion that it would be natural, when treating adults, to move the teeth in these same directions and rather avoid expansion of the dental arch in the first place. For such individual tooth movement fixed appliances may be employed.

Andresen has clinically shown that expansion of the jaws in adults is possible, provided a functional apparatus, the activator, is used.

The individual tooth movements being accomplished, one may, during a second period of treatment, expand the jaw or adjust the position of the teeth by using an activator (a removable appliance which stimulates growth). This plan of treatment, which is the reverse of the one used in younger patients, has proved favorable in cases of extreme contraction of the maxilla. Such cases are often complicated by mesial drift of the buccal segments. On account of this, one has to extract teeth in order to procure sufficient space. Conclusions may be summarized as follows:

1. Malocclusion in adult patients often has an etiologic factor, mesial drift of buccal segments after eruption of the second and third molars.

2. While in the child the physiologic tooth movement and tissue changes may be regarded as processes of growth, in the adult they are to a great extent an expression of changes caused by the function of the masticatory apparatus.

3. The physiologic wandering of the teeth in the adult is mainly limited to a tooth movement in mesial or distal direction and treatment with mechanical appliances should preferably be conducted in accordance with this conception. In the adult, expansion of the dental arch by mechanical means, should be carried out carefully and slowly in order to avoid relapse and resorptive destruction of the labial or buccal bone crest.

4. Individual tooth movement in labial or lingual direction, by means of mechanical appliances, may be performed with less danger of relapse, provided this change in position of the teeth brings them in a more favorable relation as far as function is concerned.

5. Relapses occurring a longer period after the treatment is finished are less frequent than in children, because the adult is beyond the period of maximal growth.

Lantern Slides: A New Technique: By M. Muschat, M.D., F.A.C.S., *J. Lab. & Clin. Med.* **26**: 1224-1230, April, 1941.

A novel method of slide preparation is presented, that is easy to handle and is low in cost. It consists of a very thin frosted paperlike film, upon which one can typewrite, draw with a pencil or pen and India ink, and even use water colors with good results. This material can be handled without difficulty, for it keeps its shape and does not become smeary. It possesses all the qualities and characteristics of a fine drawing or tracing paper. After the drawing or typing is completed, the frosted sheet is placed between two glass slides, bound with tape, and is ready for use. Thus an original drawing or chart can be prepared without having to resort to photography.

Material Used.—The frosted film is available on the market as "Traceolene" (light weight only), "Frosted Protectoids" (three weights or thicknesses: light, medium, and heavy), and "Plastacele" (varied thicknesses). In testing various thicknesses their optimum usefulness for specific purposes was found.

Typewriting.—The frosted film, cut into strips of 9.2 cm. width, is placed in the typewriter. The typing is done on the frosted side. It is better to use a few sheets of ordinary paper behind it, to obtain a sharper print. An extra black ribbon will produce darker print and show up better on the screen. The best double print: front and back. One can utilize the entire surface area of the frosted film, leaving a margin of about 2 to 3 mm. for the binding tape. The surface area thus available is 55 per cent greater than in the commercial cellophane method marketed as "radio mats."

TABLE I

	LEAD AND CARBON PENCILS	INK	INDIA INK	STAMP	TYPE	PENCIL ERASURES	INDIA INK REMOVAL BY SCRATCHING	CLARITY OF TYPE	HANDLING
1. Cellophane	None	Poor	Poor	Poor	Fair	None	Poor	Smeary	Smeary
2. Traceolene or frosted: 88 AB	Poor	Poor	Good	Fair	Good	Good	Fair	Clear	Clean
3. Frosted: 150 AB	Good	Poor	Good	Fair	Good	Good	Good	Clear	Clean
4. Frosted: 300 AB	Poor	Poor	Good	Poor	Poor	Good	Good	Clear	Clean

Some projectors and lantern slide carriers are so constructed that they cut in on the sides of lantern slides in which the data extend too far to the right or left. It is advisable, therefore, to have the contents of the slide cover

a space of only 7 cm. vertically and 7.5 cm. horizontally. This allows a space on the left of the image for attachment of a label or tab on which are noted the necessary data as to the owner, the nature of the contents, and the number of the slide.

Plain rubber stamping can also be used. If partial legends are required, they should be printed with the proper spacing. The frosted paper is then cut to the correct size and placed on the drawing or directly on the slide as needed.

Drawing With Pencil.—In drawing an object on frosted film the same method is employed as when using ordinary paper. I recommend the use of carbon pencils since the marks left by these pencils will show up better on the screen. By using shaders dipped in carbon pencil dust on a sandpaper board, I was able to draw the most delicate shadings desired. Shaders are made by cutting and sandpapering to a point ordinary erasers and pieces of cork. A sharp, pointed pencil may be used on this frosted material without tearing or wrinkling. The film will stand erasing with hard and soft rubber.

Drawing With India Ink.—The finest lines can be drawn on frosted film with pen and India ink. I drew charts and graphs on it the same as I do on fine drawing paper. Brilliant results may be achieved. Scratching out of the ink is easy. Ink smears on the glazed back may be wiped off with a wet sponge.

Shading of Areas.—For this work I have utilized a special cellophane film with various designs or patterns of dots and lines printed on it. It is called "Transograph Shading Film"—A. Standard nonadhesive, and B. Contak adhesive back. Spaces and columns were shaded by pasting them on the frosted film.

The shading film is useful in many ways. When using the Contak with the adhesive back, one side of the film is covered with a white paper upon which one can draw with pencil or ink. After the required area is marked off, it is cut out. The protective white paper is then lifted off and the pattern is pasted directly on the frosted film. In order to produce varied shadings, the same film is pasted on the first layer of film, with the design running in a different direction. Many different types of shadings can thus be obtained. The handling is very simple and clean, and the final effect on the screen is brilliant.

Tracings.—The frosted film is adaptable as a tracing paper in making a tracing of any desired image. By placing it upon the picture and fixing it with Scotch cellulose tape, one can trace any minute detail, either with carbon pencil or India ink.

Color Slides.—Many desired effects in flat color can be obtained by the use of colored cellophane. The cut-to-shape colored cellophane, pasted on the frosted film, produces an effective color on the screen for differentiation. It can be pasted on the adhesive side of adherent cellophane, thus fixing it in permanent position. Colored cellophane is used for square and round graphs.

Permanency.—Slides made of frosted film are superior to thin cellophane in maintaining their shape and clarity over a long period of time. Under ordinary conditions they will not warp or wrinkle, and the type will not fade.

Editorial

The Pan-American Orthodontic Meeting Well On Its Way

In keeping with the trend of the times, also in harmony with the long range plans of all of the countries within the western hemisphere, important plans are now well on the way for a Pan-American Orthodontic meeting at New Orleans, La., United States of America, in March, 1942.

The president of the American Association of Orthodontists, who obviously has both sponsored and inspired the move, advises that the Pan-American Meeting will be held in conjunction with the meeting of the American Association of Orthodontists, March 16, 17, 18, and 19. In addition to the members of the American Association of Orthodontists many men from almost all of the Latin American Countries in the western hemisphere are expected to attend. At this date (August, 1941) committees have been appointed in eighteen of the Latin American Countries, and it is expected that it will be only a very short time until committees will have been completed in all of them.

In addition to many North Americans there will appear on the program some of the leading teachers and authors of the neighboring republics to the south, and it is not too early for all orthodontists to begin to make their plans to be in New Orleans in March of 1942. If there is anything to the threadbare saying that great events cast their shadows ahead of them, it can be assumed that one of the greatest orthodontic meetings of all time is on its way under the leadership of the versatile Claude Wood, the perennial past secretary but now president of the American Association of Orthodontists, with the help of a very active Program and Interrelations Committee.

H. C. P.

Special Report

A. A. O. Public Relations Bureau

EDITOR, AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY

SIR:

The third year of work of the Public Relations Bureau opens this fall with a new hand at the helm: Dr. Frank Nicolai of Brooklyn, N. Y., succeeds Dr. T. W. Sorrels of Oklahoma City as chairman of the Executive Committee. When Dr. Sorrels' term of service expired, it was found impossible to persuade him to continue. In Dr. Nicolai the committee is fortunate in having a chairman who has acted for the past two years as the head of the Board of Directors, and under whose supervision the work has progressed to the present point. The new member of the Committee in place of Dr. Sorrels is Dr. Homer Robison of Hutchinson, Kan., who will be representative of the interests of the Middle West. His previous work in publicity at many annual meetings makes him a logical addition to the policy-forming group.

Two meetings of the committee were held during the annual meeting of the Association at the Waldorf-Astoria Hotel in New York City and since that time the Board of Directors, which is immediately in charge of the work of the Public Relations Bureau, met at the Columbia University Club, New York City, on May 27 and June 24. The purpose of these meetings was to plan the work to be undertaken during the coming season. Dr. Frank Nicolai, as chairman, presided at both meetings.

Permission was granted Dr. Miguel Mercado of the University of Mexico, to translate the leaflet "Facts About Orthodontics for Health Workers" into Spanish for distribution in Mexico.

The committee went on record as favoring renumeration of orthodontists in the employ of official or unofficial health bodies on an hourly, per session, per diem, or annual basis and at a rate equitable with that of other medical specialists similarly employed.

Plans for the coming year's work include mailing copies of "Getting Ready to Tackle Life" to members of the American Public Health Association and other organizations of persons engaged in health education. This will be done immediately after Labor Day.

A bulletin is to be issued in September on the subject of radio, which will provide every member of the society with two outstanding radio talks made during the course of the annual meeting. Transcriptions of these will be offered at cost, $5 each. Each one is good for at least fifteen broadcasts over the radio or to audiences by means of a playback machine. The two programs are: "What Is Your Face Value?" by Dr. Henry U. Barber, Jr., and Miss June Hynd, and "Why Eskimos Have Good Teeth," By Dr. Leuman H. Waugh and Dr. Donald B. Waugh.

It is planned to make it possible for Mr. Anderson to appear at future meetings of some of the District Societies. The Committee expects to procure publication of articles in several popular magazines during the coming year.

DWIGHT ANDERSON, Director, Public Relations Bureau, American Association of Orthodontists

News and Notes

Southern Society of Orthodontists

The next meeting of the Southern Society of Orthodontists will be held in Raleigh, N. C., Sept. 29 and 30, 1941.

Great Lakes Society of Orthodontists

The Great Lakes Society of Orthodontists will meet in Ann Arbor, Mich., Nov. 3 and 4, 1941.

Midcontinent Dental Congress

The Midcontinent Dental Congress will meet in St. Louis, Mo., Nov. 17, 18, and 19, 1941.

The Dental Rehabilitation Program

A program for dental rehabilitation through which registrants rejected under the Selective Service Act for dental defects could be made available for military service was approved at a special meeting of the Board of Trustees of the American Dental Association held in Chicago on August 3. This action was taken by the Board of Trustees so that organized dentistry could play its part in preparations for national defense and so that a uniform, national program could produce the most effective results in a short time. The rehabilitation program approved by the Board of Trustees was worked out by a group composed of members of the Dental Preparedness Committee, the Legislative Committee, the National Health Program Committee, the Economics Committee and the Bureau of Public Relations of the American Dental Association. In addition, representatives of various official government committees and agencies were present.

As the most effective program the American Dental Association recommends induction into the armed forces and the correction of defects by the dental personnel of the armed forces. This could be done by an adjustment of present dental standards of the armed forces.

In the event that the Congress considers legislation to provide funds for dental rehabilitation, the American Dental Association program provides specifications for the participation of the dentist, community and state. These specifications have been drawn up on the principle adopted by the House of Delegates of the American Dental Association and within a program already outlined by the official Commission on Physical Rehabilitation. Through this action of the Board of Trustees, the American Dental Association will be able to increase its effort to rehabilitate men needed for the army in time of unlimited national emergency. The full text of the rehabilitation program follows:

PROGRAM FOR REHABILITATION
OF
REGISTRANTS REJECTED FOR DENTAL DEFECTS
UNDER THE SELECTIVE SERVICE ACT

The American Dental Association recognizes that the dental rehabilitation of registrants found dentally deficient under the Selective Service Act can be accomplished in a variety of ways. It recognizes that a contribution to the national welfare can be made by the provision

of funds for dental rehabilitation, under the initiative of states, communities, and volunteer agencies, and further recognizes that such a program would not produce the most effective results in making manpower available for military service. It, therefore, recommends as the most effective program one in which dentally deficient registrants are provisionally inducted into the armed forces and then provided with the needed service by the dental personnel of the armed forces.

In the event that the Congress considers legislation providing funds for a program of dental rehabilitation, the American Dental Association recommends that the following plan form the basis of such legislation:

1. Selective Service form #200 and War Department form #221, AGO, would be amended so that: (a) the examining dentist could state whether or not the dental defects, in his opinion, were remediable; (b) registrants whose defects were remediable could be placed in special classifications to indicate the correctability of the defects; (c) registrants thus classified could signify their willingness to undergo corrective dental procedures, could permit the release of information pertinent to their remediable defects, would indicate whether or not they would provide adequate treatment out of their own resources.

2. Selective Service regulations would be amended to permit the necessary examination, duplication, and proper use of confidential records relating to the defects of the registrant.

3. The National Director of Selective Service would be asked to issue the following regulations to all local boards: the chairman of the local board shall write to all registrants in the special classifications advising them that dental defects are the primary cause of disqualification and that these defects are considered remediable in the opinion of the examining dentist; the chairman shall further advise such registrants to have the remediable dental defects corrected by their own dentist or, if the registrant is unable to bear this cost out of his own resources, to apply to the state or local Dental Rehabilitation Committee; the chairman shall further advise such registrants of the time that the board has allowed for the correction of dental defects, at the expiration of which time the registrant must report back to the board for re-examination and reclassification.

4. In all states and local areas, dental rehabilitation agencies should be established by the designated federal agency on the following basis:

> The State Dental Rehabilitation Committee shall be under the jurisdiction of the state agency designated to administer the rehabilitation program. It shall be composed of the ranking dental official in the state government (who will be the executive officer), representatives of proper state agencies, the organized dental profession . . . and such other agencies and groups as are deemed necessary. The majority of this committee shall be dentists nominated by the organized dental profession.
>
> The Local Dental Rehabilitation Committee will be under the jurisdiction of the State Dental Rehabilitation Committee. The ranking community dental official will be the executive head of this committee which shall be composed of representatives of the State Dental Rehabilitation Committee, the organized profession and such other local agencies and groups as are deemed necessary. The majority of this committee shall be dentists nominated by the organized dental profession.

The duties of the state and local Dental Rehabilitation Committees will be to collaborate with professional groups, with state and local governmental agencies and with volunteer agencies in the development of state and local rehabilitation facilities.

5. The federal government will be asked to appropriate sufficient sums of money to pay for an effective rehabilitation program, the funds to be administered by a designated federal agency through official state agencies, state and local Dental Rehabilitation Committees.

6. Federal funds are to be expended for dental care in a rehabilitation program under the following conditions:

a. Any method of rendering dental care may be employed for rehabilitation which is recognized and approved by the local Dental Rehabilitation Committee;

b. All standards of dental care rendered under this program must be in accordance with those recognized and approved by the local Dental Rehabilitation Committee;

c. The standards for dental fees and salaries under this program shall be determined by the local Dental Rehabilitation Committee based upon the standards of living in the community. A basis for determining unit-operation fees may be found in the fee schedule of the Veterans' Administration.

d. Any method of compensation for dental care may be employed in this program which is approved by the local Dental Rehabilitation Committee. This includes unit-operation, salary or capitation fee.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, Claude R. Wood _ _ _ _ _ _ _ _ 608 Medical Arts Bldg., Knoxville, Tenn.
Secretary-Treasurer, Max E. Ernst _ _ _ 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ 292 Madison Ave., New York, N. Y.

Central Association of Orthodontists

President, Harold J. Noyes _ _ _ _ _ _ _ _ _ 55 E. Washington St., Chicago, Ill.
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New York Society of Orthodontists

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Secretary-Treasurer, Robert L. Gray _ _ _ _ _ _ _ _ Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, Fred G. Hale _ _ _ _ _ _ _ _ _ _ Professional Bldg., Raleigh, N. C.
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American Board of Orthodontics

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James D. McCoy _ _ _ _ _ _ _ 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby _ _ _ _ _ _ _ _ _ 121 E. 60th St., New York, N. Y.

Harvard Society of Orthodontists

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Secretary-Treasurer, Edward I. Silver _ _ _ _ _ _ _ 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Paul W. Hoffman _ _ _ _ _ _ _ _ 1835 Eye St., N. W., Washington, D. C.
Secretary-Treasurer, Stephen C. Hopkins _ _ _ _ _ 1726 Eye St., Washington, D. C.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

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*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.

Menu at the banquet of the Angle School of Orthodontia, St. Louis, Mo., 1906. *1*, E. H. Wuerpel. *2*, George B. Palmer. *3*, E. H. Angle. *4*, F. C. Wilson. *5*, Henry C. Ferris. *6*, Martin C. Tracy. *7*, Georgette J. Cantaluppi. *8*, E. W. Sauer. *9*, Gladstone Goode. *10*, F. B. Noyes. *11*, Harold M. Clapp. *12*, A. H. Thompson. *13*, F. T. Murlless, Jr. *14*, Samuel P. Cameron. *15*, Walter Ellis. *16*, Pedro A. Diaz. *17*, F. S. McKay. *18*, Robert H. W. Strang. *19*, Martin Dewey. (Courtesy of Dr. B. W. Weinberger, New York, N. Y.)